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CIVIL ENGINEERING.

Report of H. HAUPT, Civ. Eng. *Chairman of the Committee on Civil Engineering and Inventions, appointed by the Maryland Institute, on Bollman's Patent Iron Suspension Railroad Bridge,* [October, 1854.]

To form a just appreciation of the merits of any invention which professes to be an improvement, and especially to enable a correct decision to be made upon the claims of competitors to superiority, it is necessary that certain general principles be established and required as a standard to which particular cases may be referred.

In the consideration of the relative merits of mechanical inventions, it seems to be necessary first to fix and determine what is the object sought? What is that standard of perfection towards which the nearest possible approximation is attempted?

The great desiderata in the construction of bridges appears to be—

1. *Strength;* by which is understood efficiency of resistance, or the ability to sustain without danger of fracture the greatest load that can by any possibility be thrown upon the structure.

2. *Durability,* or the ability to sustain such loads at the least cost from deterioration or repairs.

3. *Rigidity,* or the powers to resist the change of figure by the action of variable loads.

4. *Incombustibility.*

5. *Economy in first cost,* which includes a minimum of materials and workmanship.

7. *Compensation for Expansion,* which is essential in all metallic bridges.

6. *Facility of Repairs,* which usually includes simplicity of construction.

It appears evident that the structure which possesses in the highest degree the essentials above enumerated, must approach most nearly to the standard of perfection.

All materials used in sustaining loads must depend for their efficiency upon their powers of resistance, and these resistances must be exerted against forces that are either tensile or compressive.

The simplest forms of these resistances are exhibited in chains and posts; beams exposed to cross strains include both.

The chain or polygon suspended between resisting points and the arch, depend for their efficiency upon their powers of resistance to tensile and compressive forces, and are evidently the most simple forms in which a given amount of resisting material can be disposed with a given rise or deflexion, and with a given span.

With a stationary load the chain or cable assumes and maintains a position of stable equilibrium; it has no tendency to change of figure, and fulfils every condition of perfect efficiency of resistance; but with variable loads it is unstable, except where there is but a single point of application of the weight, and it cannot oppose a satisfactory resistance unless connected with some other system capable of conferring upon the combination the requisite rigidity.

An arch like the suspension chain is capable of opposing an efficient resistance to any constant load, where its figure conforms to that of the curve of equilibrium for the applied weight; but unlike the catenary, its position is unstable; the smallest disturbing force would be sufficient to cause its failure, unless connected with a system capable of resisting the action of variable loads.

It is almost self-evident that where the problem is to determine the best form to sustain a given constant weight with the minimum quantity of material, the arch or the chain must be adopted as the arrangement which best fulfils this condition.

If an arch or chain can be secured against changes of figure from the action of variable loads, its sustaining power will be perfect, and as it has been shown in published works on bridge construction, that a much smaller force is sufficient at any given point to prevent changes of figure, than to sustain the load, it follows almost as a necessary consequence that the bridge which exhibits the greatest strength with a given quantity of material must depend for its sustaining power upon some application of the aid or of the suspension chain or rods.

The plan under consideration, known as Bollman's Bridge, will now be tested by an application of these principles.

1. *Strength.*—Where the material is sound, the strength of the structure will be nearly in proportion to the cross sections of the sustaining rods and stretchers, and by varying the size of their supports any required capacity for resistance can be secured.

2. *Durability.*—As the sustaining parts are of a durable material, and as the perishable portions of the structure are attached by means which admit of ready renewals without obstruction to the trade or travel which passes over it, this condition is also very satisfactorily fulfilled.

3. *Rigidity.*—The sustaining power is derived from the tensile resistance of rods, the weight upon which varies in amount, but not in the

position of its point of application so far as each system is concerned; *of course there is no tendency to change of figure in the tension rods.*

These rods are connected with the ends of the top chord or stretcher, which must be sufficient to resist the lateral flexure which the compressive forces acting upon it have a tendency to produce. This tendency is effectually resisted by the lateral bracing in a horizontal direction, and vertically by the posts and truss rods which support it. If these points of support are sufficiently near to each other the stretcher cannot yield except by crushing, which must be guarded against by a sufficient area of cross section. The arrangement therefore fulfils the condition of perfect rigidity—*there can be no change of figure except that which is due to the elasticity of the material.*

4. *Incombustibility* is secured by the nature of the material employed.

5. *Economy in first cost.*—This is a consideration of much importance, and upon it will turn the relative advantage of the various plans of construction in general use. Many of these plans possess decided merit, most of them by a proper proportion of the parts can be made to fulfil the most important conditions of an efficient structure. In fact, the combination of the arch with a counter-braced truss of any description generally gives the requisite degree of strength and rigidity; but all are not equally economical in first cost or in cost of repairs; all are not on a par in the facilities offered for renewals or in durability.

The first and most important question for consideration refers to the distribution of material in the main supports. Is the arrangement such as will give the greatest resistance with a given quantity of material?

Referring to the description of the Harper's Ferry Bridge on the Baltimore and Ohio Railroad, it appears that there are nine posts, eight panels, and seven distinct systems of support, each system acting independently of the rest, but sustaining its own share of the weight of the structure, which appears to be about one-half ton per lineal foot.

Estimated in reference to the permanent weight of the structure, the sustaining effect of these seven systems will be almost precisely the same as that of a catenarian chain or polygon containing an equal quantity of material, and the arrangement would involve no loss of material, and as a consequence, no unnecessary expenditure for this object.

But if the structure is designed to resist the action of a heavy variable load passing over it and acting separately and successively upon each of the seven systems, a wide difference will be found to exist in the results, and the proposed plan will involve a much larger expenditure of material than the arch, the single chain, or polygon.

To render this apparent, for the purpose of illustration, let w represent the weight of the structure. As there are eight panels or spaces, each of them would represent a weight of $\frac{w}{8}$ and as each system carries a weight equal to that of one panel, $\frac{7}{8}$ w will represent the weight sustained by the whole.

If a locomotive of the heaviest class pass over the bridge, the weight upon one panel or upon one of the systems of support may be about double the permanent average load for the remaining panels or supports, and if so, will be represented by $\frac{2w}{8}$.

This weight must be sustained successively by each of the seven systems, and the united power of resistance for the variable load must be

$$\frac{2w}{8} \times 7 = \frac{14w}{8}.$$

The whole sustaining power of the rods must therefore be

$$\frac{7w}{8} + \frac{14w}{8} = \frac{21w}{8}.$$

The ability to resist with perfect security a given weight for a short interval, practically insures the ability to sustain the same weight for a greater length of time, and if one of the seven systems is sufficient to sustain a locomotive while passing a single panel, it is sufficient to sustain it during the whole time of passing the bridge. An arch or a chain, under similar circumstances, sustaining the weight of the structure and of one locomotive, would be required to oppose a resistance of only

$$\frac{7}{8}\,w + \frac{2w}{8} = \frac{9}{8}\,w.$$

The difference in the quantity of sustaining material required in the two cases is

$$\frac{21}{8}\,w - \frac{9}{8}\,w = \frac{12}{8}\,w = 133 \text{ per cent. against the}$$

sustaining arrangement exhibited in Bollman's bridge.

But the case supposed is not that which must determine the proportion of the parts in practice. A locomotive is usually followed by a train of cars, and the weight of the train may be taken at an average of half the weight per foot of the locomotive, and equal to that of the structure; in this case, the arch or chain must sustain a load represented by

$$\frac{6}{8}\,w + \frac{7}{8}\,w + \frac{2}{8}\,w = \frac{15}{8}\,w.$$

The Bollman plan, requiring a sustaining power of $\frac{21}{8}$ w would in this case also involve an excess of material equal to $\frac{6}{8}$ w, or 40 per cent.

Although the expression $\frac{15}{8}$ w represents the usual load upon the bridge caused by the passage of a train, it is not the maximum load; and it is the maximum load, and that only, which should determine the dimensions of the parts.

This load upon a railroad bridge is equal to a train of locomotives, and the sustaining power necessary to resist it is $\frac{21}{8}$ w, which is the same with the arch or catenary, as in the plan under examination.

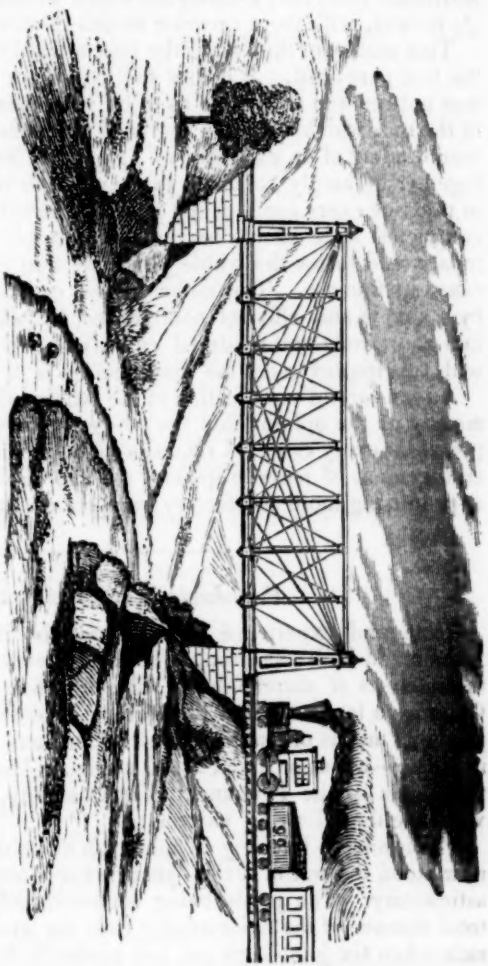
From these considerations the conclusion is deduced, that *when the maximum load is upon the bridge, the seven systems of sustaining rods require no greater amount of material than a single system capable of opposing an equal resistance.*

But a single system, whether an arch, a catenarian curve, or a polygon, requires the assistance of a truss to resist change of figure and enable it to sustain a variable load.

The arrangement in Bollman's bridge having no tendency to change of figure, requires no such assistance as far as the suspension rods are concerned, but it must be observed that these rods transmit the strains to the stretcher, which is compressed to the same extent as the arch in ordinary systems, and requires the aid of trusses both in vertical and

horizontal planes to give it the requisite stiffness. The same truss which is required to give stability to the upper chord or stretcher, would generally be sufficient to counterbrace the arch, where such an arrangement is substituted for it.

It follows, therefore, that while the Bollman plan does not require a greater sectional area to sustain the maximum load than the arch or catenary, it does not appear to require less, and that all these systems of support are nearly on an equality as respects the quantity of material requisite to sustain the maximum load.



In the details of Bollman's bridge several very meritorious arrangements are presented, one of the most valuable of which is the security against injury in the event of the fracture of any one of the main sustaining rods, the panel rods being sufficient to support the load and transmit it to the systems on each side. This advantage is of course secured by an additional expenditure of material, but the benefits are amply sufficient to compensate for it.

No data have been furnished by which to compare the cost of bridges on this plan, with others of equal strength, but it is believed that no material differences can exist where the proportions are properly adjusted.

The sixth requisite in a good plan of bridge is the ability to make repairs with facility; in this respect the plan under examination is unexceptionable.

The last essential, and one which is indispensable in a metallic structure, is the power of compensation for changes produced by variations of temperature.

From the published record of observations at the Harper's Ferry bridge, it appears that the variation in the length of the structure from changes of temperature amounts to $\frac{5}{8}$ of an inch.

The variation of the rods from the usual tables of expansion should be about 1 inch, making an uncompensated difference of $\frac{3}{8}$ in the whole length.

The observed motive difference at the first post was $\frac{3}{16}$ of an inch towards the short rod, a difference which would probably have been found $\frac{1}{16}$ greater, with more accurate means of observation.

This motion of the end of the post towards the short rod is resisted by the first panel rod. If before the expansion took place this panel rod was not secured so tightly as to be in a state of tension, the expansion of the rod, which would be nearly $\frac{3}{16}$ of an inch, and the elasticity which would admit of an extension of $\frac{1}{1400}$ of its length without injury, would together be amply sufficient to provide the requisite compensation; but in practice every contingency must be provided for, and if the rod in its contracted state should be tightly screwed, the expansion of the long rods would throw the whole weight at that point upon it, and probably cause its fracture. This defect in the original plan has been obviated by a simple and efficient contrivance, by which the action of the long and short rods are rendered entirely independent of each other, and with this improvement the *compensation is perfect in every part.*

After a careful examination of the whole subject, the Judges are unanimously of the opinion that the Bridge constructed by Wendal Bollman possesses every essential requisite of an efficient structure, and that no arrangement of parts in general use can be considered superior to it, or as promising more satisfactory practical results.

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*Fish Joints in Rails on Railroads.**

Time and experience have proved the invention of Messrs. W. B. Adams and R. Richardson, to be most successful, and most fortunate for the interests of shareholders. The little fish-joint has saved the Eastern Counties a large amount of working expense; indeed, it has been a principal means of making dividend for them. The cost of fish-jointing is trifling—about or under £200 a mile. This valuable invention is in the hands of the Permanent Way Company, from whose account of it we make the following extracts:—

"This simple but very efficient plan of uniting the ends of the rails has now stood the test of several years' experience, and the result is highly satisfactory. The joints being accurately adjusted, there is an almost total absence of the noise arising from the wheels striking the ends of the rails when the joint-keys are not perfectly tight in the chairs; consequently the engines and carriages run smoothly and with diminished oscillation, an effect that is frequently remarked by passengers, who are not acquainted with the cause, but who judge only by the greater comfort in traveling over a line so jointed.

"It is obvious that if percussion and oscillation are diminished, a saving in wear and tear of rolling stock must be the consequence, although it is not possible to estimate the precise money-value of such saving, in consequence of the carriages having to run over railways of every variety

* From Herapath's Journal, No. 808.

of construction, and a portion only of the lines of this kingdom being as yet fish-jointed.

"The same cause which lessens the wear and tear of rolling stock makes the rails last longer; and a more accurate estimate may be formed of the economy in this important part of railway construction. Experience proves that the increased duration of fished rails may be safely estimated at 25 per cent., probably even more: rails on the Eastern Counties line, considered very nearly worn out, were fished three years ago, and are still existing in fair order and under heavy traffic. It is equally obvious that the economy must extend to the sleepers and maintenance of way. In the latter item we are able to come to actual results, by a knowledge of the reduction in labor: and this is found, by the accounts of more than three years, to amount to one-half the sum previously paid.

"This statement is made on the authority of the half-yearly accounts of the Eastern Counties Railway, upon which line the system was first tried on a large scale, and it is corroborated by the fact that a contract for the maintenance of 140 miles of the main line of the Midland Railway has lately been let, one of the conditions being, that those parts of the line which are fish-jointed (together with some other portions laid under the Permanent Way Company's patents) are charged £50 per mile per annum less than the road of the old construction.

"The advantages obtained by fish-jointing may be stated to consist in—

"1st. A saving in the cost of labor for maintenance, of at least 40 per cent.

"2d. Increased durability of rails at least 25 per cent., and probably as much upon the sleepers.

"3d. A saving in wear and tear of rolling stock.

"4th. Less power being required for traction, a consequent saving of coke to produce that power.

"5th. The avoidance of accidents arising from bad joints.

"6th. Greatly increased comfort to the passengers.

"7th. Higher speeds may be used with equal safety."

For the Journal of the Franklin Institute.

Disquisition on the Laws regulating the Slips of Screw Propellers in function of Form and Dimensions; based on a Digest of the Experiments made in 1845 *by M. Bourgeois, Engineer de Vaisseau, at the French Government Manufactory at Indret.* By B. F. Isherwood, Chf. Eng. U. S. Navy.

(Continued from page 231.)

Of the influence exerted on the Slip by the employment of an oblique Generatrix.

In order to determine the effect of an oblique generatrix, an experiment was made on screw P, which screw had the following dimensions, viz:

Diameter,	15·75 inches.
Diameter of hub,	2·95 "
Pitch,	35·43 "
Length on axis,	3·39 "
Area of the screw projected on a plane at right angles to axis,	72· sq. inches.
Number of blades,	4.
Fraction used of the pitch,	0·381.

This screw was full threaded, the generatrix was straight and tangent to an inner cylinder, the blades being inclined 100° and 80° to the plane of the axis. The directrix was curved. With this screw two double courses were ran, propelling with the obtuse face of the blades; *the mean slip was* 32·8 *per centum;* minimum 31·4, maximum 34·3 per centums.

The blades were then shifted so as to propel with the acute face, and two double courses ran; *the mean slip was* 33·0 *per centums*, minimum 32·0, maximum 34·1 per centums.

The same screw, but having its generatrix straight and normal to the axis of the cylinder, was then experimented with. The mean of three double courses ran gave a slip of 34·5 per centum; minimum, 30·7; maximum, 37·1 per centums.

From the above trials, it is evident, that an oblique generatrix exercised no influence on the slip of the screw, as the mean slip when propelling with the obtuse, acute, and normal faces, were respectively 32·8, 33·0, and 34·5 per centum, which may be taken as experimentally equal.

Of the Influence exerted on the Slip by the employment of a curved Directrix or expanding Pitch.

The experiments made with three screws of widely differing proportions, are accepted for the determination of the influence exerted on the slip of the screw by curving its directrix, or giving it an expanding pitch. The experiments were made with each screw, first by propelling with its pitch in the normal position; that is, having the least pitch at the anterior edge of the blade:—then by reversing the screw on its axis and propelling with the greatest pitch at the interior edge:—and, finally, by taking the curvature out of the directrix, which was thus made straight and of a pitch equal to the mean pitch of the curved directrix. By this mode of experimenting, it is plain, that the influence of the expanding pitch can be correctly arrived at; for were that influence nothing, the screw would give sensibly the same slip with either pitch at the anterior edge, or with an uniform pitch throughout equal to the mean of the expanding pitch. If an influence was exercised it would be shown by the difference between the slip when propelling with the least and with the greatest pitch at the anterior edge of the blade; the slip with the uniform mean pitch being a mean between them. The following table contains the data and results of these experiments, viz:

Diameter of the screw.		DIAMETER.		PITCH.					SLIP.		Generatrix.	Remarks.
		Diameter of the screw, in inches.	Diameter of the hub, in inches.	Pitch (mean) of the screw, in inches.	Fraction used of the pitch.	Ratio of the pitch to the diameter of the screw, the diameter being unity.	Number of blades of the screw.	Length of the screw in the direction of the axis, in inches.	Projected area of the screw on a plane at right angles to axis, in square inches.	Number of double courses ran.	Mean slip of the screw in per centums of its speed.	Minimum and maximum slips of the screw, in per centums of its speed.		
Q		13·62	2·95	17·32	1·000	1·27	5	3·46	139	6	26·2	23·8 28·9	Straight and normal to axis.	Screw in normal position.
		"	"	"	"	"	"	"	"	6	45·5	44·6 47·9	" "	Screw in reversed position.
		"	"	"	"	"	"	"	"	6	31·4	30·0 33·8	" "	Screw with pitch made uniform.
R		15·75	2·94	19·69	1·000	1·25	5	3·94	183	6	20·0	18·3 22·4	Straight and normal to axis.	Screw in normal position.
		"	"	"	"	"	"	"	"	3	32·3	32·0 32·5	" "	Screw in reversed position.
		"	"	"	"	"	"	"	"	6	24·3	22·8 25·9	" "	Screw with pitch made uniform.
S		15·75	2·95	35·45	0·381	2·25	4	3·38	72	3	34·5	30·7 37·1	Straight and normal to axis.	Screw in normal position.
		"	"	"	"	"	"	"	"	1	56·9	——	" "	Screw in reversed position.
		"	"	"	"	"	"	"	"	2	42·0	42·0 42·0	Curved slightly.	Screw with pitch made uniform.

With screw Q the curvature of the directrix of each blade was such, that tangents at the extremities made with the chord an angle of 8° at the anterior, and 10° at the posterior edge. The mean of the slips of the trials made first with the least and then with the greatest pitch at the anterior edge was $\left(\frac{26{\cdot}2+45{\cdot}5}{2}=\right)35{\cdot}8$ per centum, or a little more than the slip 31·4 per centum, with the uniform pitch equivalent to the mean of the expanding pitch.

With screw R the curvature of the directrix is not given, but must have been nearly the same as screw Q. The mean of the slips of the trials made first with the least and then with the greatest pitch at the anterior edge was $\left(\frac{20{\cdot}0+32{\cdot}3}{2}=\right)26{\cdot}1$ per centum, or a little more than the slip 24·3 per centum, with the uniform pitch equivalent to the mean of the expanding pitch.

With screw S the curvature of the directrix of each blade was such, that tangents at the extremities made with the chord an angle of 8°. The mean of the slips of the trials made first with the least and then with the greatest pitch at the anterior edge was $\left(\frac{34{\cdot}5+56{\cdot}9}{2}=\right)45{\cdot}7$ per centum, or a little more than the slip 42·0 per centum, with the uniform pitch equivalent to the mean of the expanding pitch.

The differences between the slips of the screws when propelling with the straight directrices and when propelling with the curved directrices, taking for comparison the mean of the slips with the latter, were as follows, viz:

Designation of the screw.	Slip with the straight directrices.	Mean slip with the curved directrices, normal and reversed.	Difference, in per centums of the slip with the straight directrix.
Q.	31·4	35·8	14·0
R.	24·3	26·1	7·4
S.	42·0	45·7	8·8
Means,	32·6	35·9	10·1

From which we see, that the mean slip with the curved directrices, normal and reversed, was one-tenth more than with the straight directrices, whose pitches were equal to the mean pitches of the curved directrices. Supposing the experiments to be strictly correct, this would show that the *actual propelling* mean pitch with the curved directrices was one-tenth greater than with the straight directrices; a result which might have been expected from the fact, that when propelling with the greatest pitch at the anterior edge, the portion of the surface with the least pitch at the posterior edge must be exercising but very little propulsive effort; while when propelling with the least pitch at the anterior edge, the portion of the surface with the greatest pitch at the posterior edge must be exerting a very considerable propulsive effort. The *real propelling* mean pitch

when first the least and then the greatest pitch is used at the anterior edge, must be greater than the single average of these two pitches, which result we find to be the case by the experiments. This simple average may express exactly the *real propelling* mean pitch when the least pitch is used at the anterior edge; but it evidently cannot, from the nature of things, when the greatest pitch is so used.

There remains to compare the difference between the slips of the screws with curved directrices and propelling normally with the least pitch at the anterior edge, and the slips of the same screws with straight directrices whose uniform pitches equal the simple average of the least and greatest pitches of the screws with curved directrices. This is done as follows, viz:

Designation of the screw.	Slip with the straight directrices.	Mean slip with the curved directrix, propelling normally.	Difference in per centums of the slip with the straight directrices.
Q.	31·4	26·2	16·6
R.	24·3	20·0	17·7
S.	42·0	34·5	17·9
Means.	32·6	26·9	17·4

From the above we see, that with screws Q, R, and S, the employment of the curved directrix gave for a mean, a decreased slip of 17·4 per centum of the slip with the straight directrix, or, in round numbers, say a decreased slip of one-sixth; that is to say, if a screw with straight directrix gave a slip of 30 per centum, it would give with a curved directrix whose mean pitch equaled the pitch with the straight directrix and whose curvature was such that the tangents at the extremities of the blade made angles of 8° with the chord, a slip of 25 per centum. The amount of decrease in the slip will, of course, depend on the absolute slip of the screw and on the degree of curvature given to the directrix; too great a curvature can be given, for the initial pitch may be made relatively to the final pitch so small that its longitudinal speed will be exceeded by the speed of the vessel, when no propelling effect would be exercised by that portion of the blade on the water.

Of the Influence exerted on the Slip by the diameter of the Screw.

For the determination of the influence exerted on the slip of the screw by the length of its diameter, we can compare the results from screw H, 5th series, table I, with the results from the screws of the 1st series, same table. Also, the results from the screws of the 4th series, table II, with those from the screws of the 2d series, same table. And, finally, we can compare the results of screw Q with those from screw R.

And first, comparing the screws of the 1st and 5th series, table I. Now as the screws of the 1st series give consistent results, it is only necessary to take screw F, the one most nearly resembling screw H in amount of slip, number of blades and ratio of the diameter to the pitch, and compare its results with the results of screw H. The pitch of screw F is 31·50

inches and its slip is 35·6 per centum; the pitch of screw H is 24·25 inches; the ratio of the pitches is therefore $\left(\frac{31{\cdot}50}{24{\cdot}25}=\right)$ 1·3, and if the two screws had been of the same diameter the slip of H would have been $\left(\frac{35{\cdot}6}{1{\cdot}3}=\right)$ 27·4 per centum, but it actually was 35·7 per centum, the ratio being $\left(\frac{35{\cdot}7}{27{\cdot}4}=\right)$ 1·303. Now the diameter of screw H was 13·62 inches, and of screw F 15·75 inches, the ratio being $\left(\frac{15{\cdot}75}{13{\cdot}62}=\right)$ 1·156, the square of which is 1·336, or nearly the same as 1·303. We therefore see, that other things equal, the slip of the screw decreases in the ratio of the square of the diameter.

Again, let us compare screw L, 2d series, table II, with screw N of the 4th series, same table; these screws resembling each other in number of blades and ratio of the diameter to the pitch. The pitch of screw L is 39·37 inches and its slip is 52·6 per centum; the pitch of screw N is 30·71 inches, the ratio of the pitches is therefore $\left(\frac{39{\cdot}37}{30{\cdot}71}=\right)$ 1·282, and if the two screws had been of the same diameter the slip of N would have been $\left(\frac{52{\cdot}6}{1{\cdot}282}=\right)$ 41·0 per centum, but it actually was 60·3 per centum, the ratio being $\left(\frac{60{\cdot}3}{41{\cdot}0}=\right)$ 1·471. Now the diameter of screw N was 12·28 inches, and of screw L 15·75 inches, the ratio being $\left(\frac{15{\cdot}75}{12{\cdot}28}=\right)$ 1·282, the square of which is 1·643. The discrepancy here is between 1·471 and 1·643, or ten and a half per cent. of the greater number.

If we compare screw O of the 4th series, which was of the same diameter as screw N, with screw K of the 2d series, which resembled it in number of blades and in the ratio of the diameter to the pitch, and which had the same diameter as screw L, making the comparison as above, we find that had screw O been of the same diameter and pitch as screw K, its slip would have been 29·5 per centum, but it actually was 43·6 per centum, the ratio being $\left(\frac{43{\cdot}6}{29{\cdot}5}=\right)$ 1·478. The squares of the diameters of the two screws compared as 1·000 to 1·643, the discrepancy being here also, as in the immediately preceding case, ten and a half per cent. of the large number.

Finally, let us compare screw Q with screw R, taking for comparison the results when propelling with uniform pitches. The pitch of screw R is 19·69 inches, and its slip is 24·3 per centum; the pitch of screw Q is 17·32 inches; the ratio of the pitches is therefore $\left(\frac{19{\cdot}69}{17{\cdot}32}=\right)$ 1·137, and

if the two screws had been of the same diameter the slip of Q would have been $\left(\frac{24{\cdot}3}{1{\cdot}137}=\right)$ 21·4 per centum, but it actually was 31·4 per centum, the ratio being $\left(\frac{31{\cdot}4}{21{\cdot}4}=\right)$ 1·467. Now the diameter of screw Q was 13·62 inches, and of screw R 15·75 inches, the ratio being $\left(\frac{15{\cdot}75}{13{\cdot}62}=\right)$ 1·156, the square of which is 1·336. The discrepancy here is between 1·467 and 1·336, or nine per centum of the greater number.

If, now, we take from the foregoing experiments, the mean of the ratios between the actual slips and the slips that would have been, had the compared screws been of equal diameter and pitch, and compare it with the mean of the ratios between the squares of the diameters, we shall obtain the following result, viz:

Compared screws.	Ratios of the actual slips to the slips that would have been, had the compared screws been of equal diameter and pitch.	Ratios of the squares of the diameters of the compared screws.
F and H.	1·303	1·336
L " N.	1·471	1·643
O " K.	1·478	1·643
Q " R.	1·467	1·336
Means.	1·43	1·49

From the close agreement of these means (1·43 and 1·49) it may be considered as experimentally determined, that the slip of the screw decreases in the ratio that the square of the diameter increases, other things continuing equal, and *vice versa*.

Of the Influence exerted on the Slip by surrounding the periphery of the Screw with a Drum of very thin metal fastened to and moving with the Blades.

Many mechanicians have entertained the notion, that the screw in its rapid rotation endows the water comprised between its blades, with a centrifugal force, and that this water thrown violently from the centre towards the circumference, leaves a vacuum about the axis, which diminishing the propelling surface of the screw increases correspondingly its slip—and that by surrounding the circumference of the screw with a thin metal band or drum, this radial movement of the water existing in virtue of the imagined centrifugal force impressed upon it by the rotation of the screw, might be forcibly repressed, so that the vacuum should not obtain at the axis, but the whole surface be maintained in its propulsive action on the water.

To test this idea practically, screw Q was experimented with, propelling by its reversed face, that is to say, having the greatest pitch at the anterior and the least pitch at the posterior edge of the blades. Two double courses were ran, and the resulting slips were 44·1 and 45·8 per centum: *mean slip* 45·0 *per centum*.

The periphery of this screw was then surrounded with a thin copper drum, and the experiments were carefully repeated, propelling with the same face as before. Two double courses were ran, and the resulting slips were 47·0 and 48·0 per centums: *mean slip* 47·5 *per centum.*

The drum was now removed from this screw, the curvature of the directrix was considerably reduced, and propelling with the same face as before, three double courses were ran, giving slips of 38·3, 38·3, and 39·6 per centum: *mean slip* 38·7 *per centum.*

The drum was now restored, and propelling with the same face as before, two double courses were ran, giving slips of 41·8 and 42·9 per centum: *mean slip* 42·3 *per centum.*

If, now, in the above experiments we take the mean of the two with the drum attached to the screw, we shall obtain a slip of $\left(\frac{47{\cdot}5+42{\cdot}3}{2}=\right)$ 44·9 per centum: while the mean of the two made without the drum gives $\left(\frac{45{\cdot}0+38{\cdot}7}{2}=\right)$ 41·9 per centum. The increased slip of one-fourteenth resulting from the attachment of the drum, must be considered as due to the direct resistance of the edge of the drum and to the friction of the surface of the drum on the water. We then arrive at the conclusion, that the envelopment of the periphery of the screw by a drum, exerts no influence on the slip in function of form.

General Practical Conclusions.

By the experiments just discussed, there have been established the following *conclusions* with regard to the laws regulating the slip of the screw in function of its form and dimensions, viz:

1. *With regard to the influence exerted on the slip by the cutting out of the inner part of the blades.* That a cutting out of the inner portion of the blades, by the passage of a cylinder having the same axis with the screw and a diameter equal to half the diameter of the screw, increased the slip one-seventh; that is to say, if the slip before the cutting out was 28 per centum, it would be 32 per centum after the cutting out. Also, that a further cutting out of the inner portion of the blades, by the passage of a cylinder of coincident axis and of a diameter equal to three-fourths the diameter of the screw, increased the slip two-fifths; that is to say, if the slip of the full threaded screw before the cutting out was 28 per centum, it would be 39 per centum after the cutting out.

2. *With regard to the influence exerted on the slip by employing less than one convolution of the thread, or by fractioning the pitch.* That supposing the original screw to consist of one convolution of the thread divided into several blades, the effect upon the slip is the same for equal fractionments of the pitch, whether that fractionment be effected by the omission of blades, preserving the same length of screw, or by the diminution of the length of the screw, preserving the same number of blades, viz: that an increase of slip follows each decrease of screw surface: that this increase of slip follows no regular ratio of the decrease of surface of the screw, but is large for small fractions of the pitch, becoming gradually

very small for large fractions of the pitch; that the mean of the experiments determines the following for the ratio of the increase of slip in the case where the original one convolution of the thread was decreased successively by one-seventh at a time, viz:

Fractions used of the pitch.	Ratio of the increase of the slips.	Relative slips, supposing the slip with one convolution of the thread to be 30 per centum.
7-7 or 1·000	1·0000	30·000
6-7 or 0·857	1·0024	30·072
5-7 or 0·714	1·0369	31·107
4-7 or 0·571	1·0777	32·331
3-7 or 0·429	1·1492	34·476
2-7 or 0·286	1·2626	37·878
1-7 or 0·143	1·4463	43·389

That within the limits of one convolution of the thread and with the same screw, halving the same surface either by reducing the length one-half or by omitting one-half the number of blades, increases the slip in the same ratio, and this ratio is constant, be the absolute amounts of surface what they may; and that the ratio of this increase of slip for such a reduction of one-half the surface is 1·151 or two-thirteenths: for instance, if using *six*-sevenths of one convolution give a slip of 30 per centum, then using *three*-sevenths of the same convolution will give a slip of ($1{\cdot}151 \times 30 =$) $34\frac{1}{2}$ per centum; if using *two*-sevenths of one convolution give a slip of 39 per centum, then using *one*-seventh of the same convolution will give a slip of ($1{\cdot}151 \times 39 =$) 45 per centum, and so on.

3. *With regard to the influence exerted on the slip by employing an oblique generatrix.* That the employment of a straight line for generatrix, having its inner end tangent to an inner cylinder of the same axis as the screw, so that it made angles of 100° and 80°, with a plane passing longitudinally through the axis, exerted no sensible influence on the slip of the screw; and as a curved generatrix is only an oblique generatrix with a constantly varying degree of obliquity, it follows that no sensible influence on the slip would be exerted by a curved generatrix.

4. *With regard to the influence exerted on the slip by employing a curved directrix or expanding pitch.* That the employment of a curved directrix with such a degree of curvature that the tangents at the extremities of the blade made angles of 8° with the chord, decreased the slip of the screw one-sixth; that is to say, if a screw with a straight directrix or uniform pitch gave a slip of 30 per centum, then the same screw but with a curved directrix whose mean pitch equaled the pitch of the straight directrix, would give a slip of 25 per centum; the curvature of the directrix being as above described and the slip being calculated for the mean pitch.

5. *With regard to the influence exerted on the slip by the division of the same propelling surface into a more or less number of blades.* That the slip of the same area of the same propelling surface remains unaltered, whether that surface be arranged in one blade or many.

6. *With regard to the trepidations of the screw.* That when the propelling surface is arranged in *one* blade, the trepidations are *very strong;* when arranged in *two* blades, *light;* when arranged in *three* blades, *nearly insensible*, and when in *four* blades they entirely *ceased.*

7. *With regard to the influence exerted on the slip by the greater or less rotary speed of the same screw.* That the slip of the same screw remained constant at all rotary velocities, the speed of the boat being in the direct ratio of the number of revolutions made by the screw in a given time.

8. *With regard to the influence exerted on the slip by surrounding the periphery of the screw with a thin metallic drum of the same length as the screw, fastened to the blades and turning with them.* That the application of such a drum produces no effect on the slip.

9. *With regard to the influence exerted on the slip by arranging the blades checkerwise.* That the arrangement of the blades checkerwise, which is done by taking half the number of the blades, moving them back their length, and positioning them so that the rear blades intersect the spaces between the front blades, which arrangement causes the screw to be of double length in the direction of the axis, exerts no influence on the slip of the screw.

10. *With regard to the influence exerted on the slip by the length of the pitch.* That the slips of otherwise equal screws are in the direct ratio of the pitches; that is to say, doubling the pitch doubles the slip.

11. *With regard to the influence exerted on the slip by the length of the diameter of the screw.* That the slips of otherwise equal screws are in the ratio of the squares of the diameters; that is to say, halving the diameter increases the slip four times.

(To be Continued.)

For the Journal of the Franklin Institute.

Remarks on W. Truran's *Article on Errors committed by Writers on Mechanical Engineering.* By Thomas Prosser, Civ. Eng.

In the March number of the *Journal*, is an article on "*Errors committed by writers on Mechanical Engineering*," by William Truran, Esq., which is certainly astonishing, not for the errors which it exposes, but for those which it commits.

The quoted assertion of Desaguliers, that "two men working at a windlass with handles at right angles to each other, can raise 70 lbs. more easily than one can raise 30 lbs.," has reference only to their physical organization, which is supposed to enable them to work with greater advantage when one man is laboring most and the other least, and thus equalizing the labor or strain at certain points, which otherwise would test the strength too severely to be endured; just as a man may in some cases perhaps, lift or carry 60 lbs. 70 feet with greater ease than 70 lbs. 60 feet, although the mere mechanical performances are precisely equal. That "the majority of educated scientific men in Europe believe that a gain of power follows, when the handles of a windlass are set at right angles &c.," is a most extraordinary assertion of credulity on the part of the writer.

The gratuitous addition of C. E. to the name of the late J. C. Robertson, Esq., is very significant of the writer's accuracy, and would certainly amuse the recipient, were he alive to enjoy the joke.

Mr. Robertson was a writer to the Signet in Scotland. In 1823 he commenced the editorship of the *London Mechanics' Magazine*,* and in 1835 he connected with it a Patent Agency business. He died Sept. 25th, 1852, and this is, I believe, the first obituary notice that has ever appeared in any *Scientific Journal*, of the man, who, before the London Mechanics' Institute was established, advocated and encouraged the claims of mechanics, and identified himself with that Institute from its commencement—the man who received the highest encomiums from Dr. Birkbeck and Henry Brougham, Esq., M. P. and F. R. S., himself the most accomplished mechanic that ever argued a Patent Case in a silk gown, or sat upon a woolsack—now Lord Brougham.†

Desaguliers alludes to the "easily" doing of a thing, not to the power required to do it. One may do a thing, which another cannot do at all, or the same man do a thing one way which he cannot do another, while the absolute mechanical power which is required to do it remains precisely the same.

The quotation from Robertson I cannot find, but the language is very indefinite and quite unlike that which he usually employed in writing upon subjects which he understood, which were certainly not those alluded to; at least, he was not so eminent as has been stated, apparently in order to make out a case.

The placing of cranks at right angles to each other, was, I believe, first introduced by Bolton & Watt, nearly 50 years ago, in a rolling mill. The object in view, was, to avoid the dead centres which exist when one engine only is employed, and also to use a lighter fly-wheel to equalize the motion, a most important consideration too in a cotton mill, particularly where very fine numbers are spun. The first steamboat with two engines, was upon the Clyde, in 1813, built also by Bolton & Watt, and had the cranks placed at right angles to each other.

It is only on a locomotive, that I fancy any power is gained by placing the cranks at right angles to each other, and that is the power of throwing the engine off the rails, particularly when well "backed up" by a considerable elevation of the outer rail on going round a curve. One engine pulls on one side, and then the other reciprocates it at intervals on the other side, which, being favored by the elevation of the outer rail upon a curve, sets the engine and train rocking until it not unfrequently rocks itself off. Mr. Stephenson took some such view of the

* In the first Vol., he noticed in his Report of the proceedings for the establishment of the London Mechanics' Institute, of which he was one of the Secretaries, that one of the speaker's mode of pronouncing some words, excited a smile, and his friends must have smiled on reading it, for his own pronunciation was, for an educated man, the broadest of Scotch, and so continued until the day of his death. He was of a kindly and social disposition, but a hard worker withal.

† The man who originated almost, the London Mechanics' Institute, and who had therefore, if for nothing else, a right to say that "he had done the State some service," and who died in its "harness," received not one passing notice from the press, on his demise, and even the offspring which he had raised with so much anxiety and solicitude, shed not the tribute of a tear of printers' ink upon its pages, to announce to the world that its progenitor had departed this life at the age of 67.

matter when he invented his three cylinder locomotives, which, notwithstanding his high reputation, the necessity for is scarcely as yet acknowledged. And, therefore, I do not expect to make converts to the proposition which I advanced several years ago, and for the doing of which I have only obtained the abuse of those who assume to be the elite of railway engineering

New York, April 2, 1855.

For the Journal of the Franklin Institute.

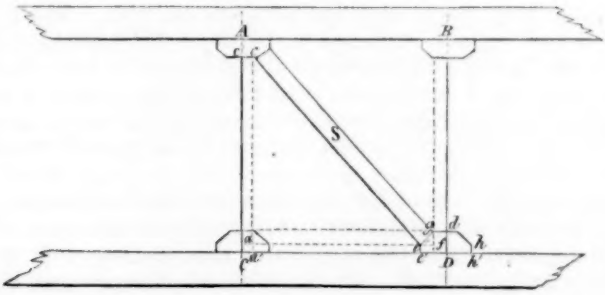
Investigation of the Angle-Block of Howe's Truss. By J. M. Richardson.

A point of great practical importance in construction is, that all the parts should fit; so that, when put together, they may constitute a perfect whole. Under-pinning, or wedging and keying, to remedy any deficiency of length, breadth, or thickness of the components, is in the highest degree deleterious, and always endangers the stability of the structure. The dimensions, therefore, of each part should be accurately determined beforehand, and no one should be received which does not correspond, in every particular, with the conditions previously ascertained.

With the view of contributing my mite towards perfecting the details of bridge construction, I submit the following general investigation of the angle-block of Howe's Truss, the diagonal brace being perpendicular to the abutting surfaces of blocks.

The quantities given in this investigation are, the distance between the upper and lower strings, the width of bay or pannel, width of brace, height of block, and distance between abutting surfaces of block.

The quantity to be determined is, the degree of inclination of abutting surfaces of blocks.



Let A B C D be a panel of Howe's truss. A B $= a'$; A C $= d''$; A $c' = c'$; $c\,c' =$ half distance between abutting surfaces of block $= e$; $e\,g = c$; $e\,f = x$; $f\,g = y$.

$a\,c = d''$; $-2\,c' + y = b + y$; $a\,e = a' - 2\,e - x = a - x$.

The right triangles, $a\,e\,c$ and $e\,f\,g$, are similar, and give the proportion, $e\,f : f\,g :: a\,c : a\,e$, or $x : y :: b + y : a - x$. Hence,

$$a\,x - x^2 = b\,y + y^2. \quad - \quad - \quad (1)$$

From $e\,f\,g$,

$$x^2 = c^2 - y^2. \quad - \quad - \quad - \quad (2)$$

From (1) and (2),

$$x = (b\,y + c^2)\,a^{-1}. \quad - \quad - \quad (3)$$

The limits of y are $y = o$, and $y = c$. When $y = o$, $c = o$, or $c = a$, and

$$x = o, \text{ or } x = a. \quad - \quad - \quad - \quad (4)$$

When

$$y = c,\ b = -c, \text{ and } x = o. \quad - \quad - \quad (5)$$

If $y = m\,c$ where m is fractional,

$$x = (b\,m\,c + c^2)\,a^{-1}. \quad - \quad - \quad (6)$$

Solving (1) with regard to x,

$$x = 2^{-1}\,(a + [a^2 - 4\,(y^2 + b\,y)]^{\frac{1}{2}}). \quad - \quad (7)$$

Substituting in (2) and reducing

$$y = -c\,(a^2 + b^2)^{-1}\,[b\,c \mp a\,(a^2 + b^2 - c^2)^{\frac{1}{2}}]. \quad - \quad (8)$$

Putting this value of y in (3) there results,

$$x = a^{-1}\,c\,(c - b\,(a^2 + b^2)\,\tfrac{1}{2}\,[b\,c \mp a\,(a^2 + b^2 - c^2)^{\frac{1}{2}}]). \quad (9)$$

Having found x and y, the inclination of abutting surface of block becomes known; for, if we denote the angle, $g\,e\,f$, by ϕ, we get

$$\text{tan. } \phi = y\,x^{-1}. \quad - \quad - \quad (A)$$

Also, if l is the length of the brace,

$$l = [\,(b + y)^2 + (a - x)^2]\,\tfrac{1}{2}. \quad - \quad - \quad (10)$$

The greatest width of block is,

$$e'\,h' = 2\,e + 2\,x = 2\,e + 2\,a^{-1}\,c\,(c - b\,(a^2 + b^2)^{-1}\,[b\,c \mp a\,(a^2 + b^2 - c^2)^{\frac{1}{2}}]). \quad (11)$$

If $a\,a' = o$, the height of the block is the unknown quantity, y, and equation (1) becomes

$$a\,x - x = a''\,y - 2\,y^2. \quad - \quad - \quad (12)$$

From (2) and (12),

$$x = (c^2 + d''\,y - 2\,y^2)\,a^{-1}. \quad - \quad - \quad (13)$$

The limits of x and y are the same as before, and if $y = m\,c$,

$$x = (c^2 + c\,d''\,m - 2\,c^2\,m^2)\,a^{-1}. \quad - \quad (14)$$

Solving (12) with regard to x,

$$x = 2^{-1}\,(a \mp [a^2 + 4\,(y^2 - d''\,y)\,]^{\frac{1}{2}}). \quad (15)$$

Substituting in (2) and reducing

$$y^4 - d''\,y^3 + 4^{-1}\,(a^2 + d''^2 - 4\,c^2)\,y^2 + 2^{-1}\,c^2\,d''\,y = 4^{-1}\,c^2\,(a^2 - c^2). \quad (16)$$

(16) may be put under the form

$$y^4 + b'\,y^3 + c'\,y^2 + d'\,y = e'. \quad - \quad - \quad (17)$$

which is the general of the equation of the 4th degree.

In (17) put

$$y = 2 - 4^{-1}\,b'. \quad - \quad - \quad (18)$$

Reducing

$$2^4 + p\,2^2 + q\,2 = r. \quad - \quad - \quad (19)$$

in which

$$p = c' - 6\cdot 4^{-2}\,b'^2,\ q = 2\cdot 4^{-2}\,b'^3 - 2^{-1}\,b'\,c' + d',\ r = e' + 3\cdot 4^{-4}\,b'\,d' + 4^{-1}\,b'\,d' - 4^{-2}\,b'^2\,c'.$$

Assume

$$2 = s + t. \quad - \quad - \quad - \quad (20)$$

(19) then becomes

$$s^4 + s^2\,(6\,t^2 + p) + t^4 + p\,t^2 + q\,t + s\,(4\,t^3 + 2\,p\,t + q) + 4\,t\,s = r. \quad (21)$$

Since but one condition has been placed on s and t, we are at liberty

to impose another; let the sum of the terms involving the odd powers of s, equal zero. Reducing, we get

$$3^2 = -(t^2 + 2^{-1} p + 4^{-1} q\, t^{-1}). \quad - \quad (22)$$

(21) now becomes

$$s^4 + 3^2 (6\, t^2 + p) + t^4 + p\, t^2 + q\, t = r. \quad - \quad (23)$$

Eliminating s between (22) and (23),

$$t^6 + 2^{-1} p\, t^4 + 16^{-1} (p^2 + 4\, r)\, t^2 = 16^{-1} q^2. \quad - \quad (24)$$

(24) is of the 6th degree, but may be reduced to the 3d, since it contains none but even powers of t. Assume

$$t^2 = 4^{-1} u. \quad - \quad - \quad - \quad (25)$$

(24) now becomes

$$u^3 + 2\, p\, u^2 + 4\, (p^2 + 4\, r)\, u = 4\, q^2. \quad - \quad (26)$$

$$\text{or, } u^3 + m\, u^2 + n\, u = v. \quad - \quad - \quad (27)$$

$$\text{Let } u = 2^1 - 3^{-1} m. \quad - \quad - \quad (28)$$

Reducing

$$2'^3 + p'\, 2' = r'. \quad - \quad - \quad (29)$$

Where

$$p' = n - 3^{-1} m^2\, r = v + 3^{-1} m\, n - 2 \cdot 27^{-1} m^3. \quad (30)$$

$$\text{Let } 2' = s' + t'. \quad - \quad - \quad (31)$$

After reduction, (29) will become

$$s'^3 + t'^3 + (3\, s'\, t' + p')\, (s' + t') = r'. \quad - \quad (32)$$

Since s' and t' have been subjected to but one condition, we are at liberty to impose a second. Let

$$3\, s'\, t' + p' = o. \quad - \quad - \quad (33)$$

(32) becomes

$$s'^3 + t'^3 = r'. \quad - \quad - \quad (34)$$

Eliminating t' between (33) and (34),

$$s'^6 - r'\, s'^3 = 27^{-1} p'^3. \quad - \quad - \quad (35)$$

Solving (35) as a quadratic,

$$s' = (2^{-1} [r' \pm (r'^2 + 4 \cdot 27^{-1} p'^3)^{\frac{1}{2}}])^{\frac{1}{3}}. \quad - \quad (36)$$

Substituting in (34) we get

$$t' = (2^{-1} [r' \mp (r'^2 + 4 \cdot 27^{-1} p'^3)^{\frac{1}{2}}])^{\frac{1}{3}}. \quad - \quad (37)$$

Now, we can find z', then u, s, t, and z, and finally x and y. Substituting the value of z', found from (36) and (37), in (28), we get one root of (27). Denote this root by u', then from (25),

$$t = \pm 2^{-1} u'^{\frac{1}{2}}. \quad - \quad - \quad (38)$$

which, in (22), gives

$$s = \pm (-[u' + 2p \pm 2 u'^{-\frac{1}{2}} q])^{\frac{1}{2}}\, 2^{-1}. \quad - \quad (39)$$

But from (20) $z = s + t$. Hence, the four roots of z are,

$$z = 2^{-1} (u'^{\frac{1}{2}} + [-(u' + 2p + 2\, q\, u'^{-\frac{1}{2}})]^{\frac{1}{2}}). \quad - \quad (40)$$

$$z = 2^{-1} (u'^{\frac{1}{2}} - [-(u' + 2p + 2\, q\, u'^{-\frac{1}{2}})]^{\frac{1}{2}}). \quad - \quad (41)$$

$$z = -2^{-1} (u'^{\frac{1}{2}} - [-(u' + 2p - 2\, q\, u'^{-\frac{1}{2}})]^{\frac{1}{2}}). \quad - \quad (42)$$

$$z = -2^{-1} (u'^{\frac{1}{2}} + [-(u' + 2p - 2\, q\, u'^{-\frac{1}{2}})]^{\frac{1}{2}}). \quad - \quad (43)$$

Subtracting $4^{-1} b$ from each of these results, the four roots of (17) are obtained.

The formulas last obtained are of so complicated a character, at least

in appearance, that the merely practical engineer may be deterred from using them. How may the process for finding x and y be simplified? It is evident that the available roots of (17) must be real and positive. Find, then, the limits of the real and positive roots of (17), by trial or otherwise, and, by some method of approximation, determine the roots to at least four places of decimals, if they are fractional.

Or proceed thus, in (13) put $y = m\,c$, where m is fractional. There results,

$$x = a^{-1}\,c\,(c + b\,m - 2\,c\,m^2) = n\,c. \quad - \quad (44)$$

Substituting this value of x in (2),

$$y = \pm\,c\,(1 - n^2)^{\frac{1}{2}} = m'\,c. \quad - \quad - \quad (45)$$

$$x = \overline{a^{-1}}\,c\,(c + b\,m' - 2\,c\,m'^2) = n'\,c. \quad - \quad (46)$$

$$y = \pm\,c\,(1 - n'^2)^{\frac{1}{2}} = m''\,c. \quad - \quad - \quad (47)$$

$$x = \overline{a^{-1}}\,c\,(c + b\,m'' - 2\,c\,m''^2) = n''\,c. \quad - \quad (48)$$

&c., &c., &c., until x and y are obtained to four places of decimals.

The solution of the problem in this form is more difficult than in the first. Having found x and y, the length of the brace becomes known, for

$$l = [\,(b - y)^2 + (a - x)^2\,]^{\frac{1}{2}}. \quad - \quad - \quad (49)$$

The simplest case is when the axis of the brace passes through the points A and D. The triangles A C D, and $e\,f\,g$, are then similar, and from them we get the proportion,

$$e\,f : f\,g :: \text{A C} : \text{C D}, \text{ or, } x : y :: d'' : a', \text{ and}$$

$$x = a'^{-1}\,d''\,y. \quad - \quad - \quad - \quad (50)$$

(50) combined with (2) gives

$$y = \pm\,c\,(a'^{-2}\,d''^2 + 1)^{-\frac{1}{2}}. \quad - \quad - \quad (51)$$

(51) in (50) gives

$$p = \pm\,a'^{-1}\,d''\,c\,(a'^{-2}\,d''^2 + 1)^{-\frac{1}{2}}. \quad - \quad (52)$$

l is found by (10) or (49), according as $a\,a'$ 7 or $= 0$.

From this discussion, it is seen that for simplicity, $a\,a'$ should be 70, and that the axis of the brace should pass through A and D. Some difficulty may be occasioned by making both of these assumptions at the same time, but this may generally be avoided by giving suitable values to e and c'. When $a\,a'$ 70, it will be well to make $c' = c$ or 7 c. The value of e is dependent, in a measure, upon the diameter of the tie-rods connecting the upper and lower strings, and which pass through the blocks.

If $a\,a' = 0$, and x and y be assumed, the width of the brace will have to be found.

I owe an apology, perhaps, for rejecting, in this discussion, the ordinary form of fractional expressions, except in the case of exponents, and the radical sign. My reason for so doing is, that I find certain advantages to accompany this method of notation. I cannot, with propriety, point out these advantages now, as it would be foreign to my purpose. The use of fractional exponents to express the extraction of roots, is very frequent now, and I see no reason why this notation should not be adopted to the entire exclusion of the radical sign.

AMERICAN PATENTS.

List of American Patents which issued from March 6th, to April 3d, 1855, (inclusive,) with Exemplifications.

MARCH 6.

1. For an *Improvement in Machines for Cleaning Sisal Hemp, and Stripping Seeds from Broom Corn;* George D. Allen, Key West, Florida.

Claim.—"The combination of the prongs with the spring levers, or their equivalents."

2. For an *Improvement in Life Boats;* John Allen, City of New York.

Claim.—"1st, A life boat composed of a frame and a flexible covering, and provided with inlet and outlet pipes and valves, so that when the flexible covering is closed up perfectly water tight, the action of the waves on said flexible covering, and the tossing about of the boat on the water, will keep up a constant pumping action, and thereby supply fresh air to and discharge vitiated air from the interior. 2d, The construction of the frame of the two tubes, and right and left hand screw, and the longitudinal ribs."

3. For an *Improvement in Cook Stoves;* J. J. Anderson, Beaver, Pennsylvania.

Claim.—"The construction of the ellipsoidal oven in stoves, arranged in contact at the front with the horizontally corrugated fire brick and detachable ash-box."

4. For an *Improved Arrangement of the Springs on Wagons;* Harman W. Ballard, Burlington, Vermont.

Claim.—"The arrangement of the springs on either or both sides of the rocker, bolster, or axle-tree of a wagon, cart, or other vehicle.

5. For an *Improvement in Guards for Door Locks;* William Ballauf and Frederick Wurth, Cincinnati, Ohio.

Claim.—"1st, The bit or case, and the bracket adapted to the slot of an ordinary key hole, in combination with the cylindrical socket and tapering screw threaded spindle, adapted to the eye of the key hole, and which spindle, by means of a suitable key, can be screwed within or unscrewed from the key hole, the rotation of the screw by any other than the proper key being prevented by the described tumblers, or their equivalents. 2d, The sliding and vibrating tumbler or tumblers, provided with a locking dent or lug, catching within a notch in the spindle shank, and disengaged therefrom by the combined agencies of the channeled and sliding key, elevating pin or piston, longitudinal and T slots, and stationary pins, the tumbler, on the withdrawal of the key, re-locking by means of a suitable spring. 3d, In combination with tumblers, the longitudinal notches extending on both sides of a transverse or eccentric channel around the spindle shank. 4th, The eccentric and parallel channel around the spindle shank and key stem, acting simultaneously upon both dent and spur of each tumbler. 5th, The tapering screw threaded and spirally scored spindle in this connexion."

6. For a *Safe Catch for Breast Pins;* E. C. Benyaurd, Philadelphia, Pennsylvania.

Claim.—"The application and use of a safe catch, for the purpose of holding safely and securely the point end of the pin of breast pins, cuff pins, chatelaines, or any other piece of jewelry requiring a catch and pin."

7. For an *Improvement in Hand Cultivators;* Nehemiah B. Chase and Chauncy W. Saunders, Wilkinsonville, Massachusetts.

Claim.—"The arrangement of the knives upon the frame, so as to be adjustable in an oblique direction, and also reversible."

8. For an *Improvement in Processes for Making Bread;* Chas. Crum, Hudson, N. Y.

Claim.—"The suffering the dough to pass into the acetous state, then reviving it by the working and breaking into it fresh dry unfermented flour, and the subsequent process of cutting, piercing, raising in the open air, and baking in an open oven or ovens freely ventilated, and I claim this invention in its application to wheat flour, or any other flour of which bread is made."

9. For an *Improvement in Treating Fish for Manure and Oil;* René Charles Demolon and Geo. Alex. Chs. Thurneyssen, Paris, France; patented in France, Jan. 13, 1851.

Claim.—"The reduction of fish, or the remains of fish, to a dry powder, for manure and other purposes."

10. For an *Improvement in Harness Saddle-Trees;* J. C. Dickey, Saratoga Springs, New York.

Claim.—"The shank piece or prolongation of the nut, for the purpose of enabling me to place the turrets higher up on the yoke where they properly belong, and to prevent the reins passing through them from being too much spread at that point, as they would be if the turrets were placed at the joint, which is limited in its position."

11. For a *Machine for Cutting Mitre and other Joints;* F. A. Gleason, Rome, N. Y.

Claim.—"1st, The rotary dove-tail groover, or its equivalent. 2d, The mitre saw, with the clearing knife fixed upon the same chuck, and concentric with the groover; also, the manner of fastening the saws. 3d, The tonguing stock, with its saw and bevel cutter, or their equivalent; also, the manner of attaching it to the head stock. 4th, The carriage, with its movable bed, which may be adjusted to any angle required."

12. For a *Direct Double Acting Hydraulic Steam Pump;* R. B. Gorsuch, City of N. Y.

Claim.—"Effecting a water pressure upon the suction end of the pump plunger, in direct acting steam pumps, at or near the completion of the stroke, without diminishing the resistance against the forcing end of the plunger, in the manner as herein shown, or in an equivalent way, for the purpose of closing the suction valves, filling the vacuous space in the pump chamber, preparing the force valves for opening and acting conjointly with the steam pressure upon the piston, whereby the steam valve is operated with precision, whatever may be its velocity."

13. For an *Improved Auger Handle Fastening;* G. H. Hubbard, Shelburne Falls, Mass.

Claim.—"The ring."

14. For an *Improvement in Soda Water Apparatus;* M. F. Hyde, Burlington, N. J.

Claim.—"The porous distributor, or its equivalent."

15. For an *Improved Coal Screen;* George Martz, Pottsville, Pa.

Claim.—"The improvement by which the coarsest coal is separated from the finer sorts, and discharged at the mouth of the screen, whilst the finer sorts of coal are carried forwards and separated, the one from the other, in the usual manner."

16. For an *Improved Mill for Grinding and Bolting Sumac;* Samuel W. Powell, Tuscarora Valley, Pennsylvania.

Claim.—"The slotted hollow cylinder, having a shaft armed with spirally arranged teeth revolving within it."

17. For an *Improvement in Steering Apparatus;* Jesse Reed, Marshfield, Mass.

Claim.—"Combining with the divided nut, the adjustable guide and guard rails. Also, the supporting of the pedestals upon the stanchions, by means of long pins or studs passing through oblong slots in the pedestals, and into said stanchions, for the purpose of allowing the pedestals, and several parts connected therewith, to move fore or aft, up or down, to accommodate themselves to any rising or falling, or springing or bending of the rudder post."

18. For an *Improvement in the Combination of an Air Chamber, Water Cooler, and Force Pump, in Soda Fountains;* Newton D. Robins, Edinburgh, Indiana.

Claim.—"The apparatus, as constructed, of a combination of a water cooler, an air chamber placed within, and force pumps."

19. For an *Improvement in Railroad Car Coupling;* E. Rice, Canandaigua, N. York.

Claim.—"The arrangement of the movable guiding mouth, the catches, the inclined planes, the embracing band, and the lever, with each other and with the draft bar, in such a manner that the coupling bar will be self-caught, and retained when brought in contact with said parts, and by which it can also be readily liberated when the cars are in motion. In combination with the spring catches and the movable mouth of the coupling apparatus, I also claim the movable heads of the coupling bar."

20. For an *Improved Fire Place;* John W. Smith and J. S. Gallaher, Jr., Washington, District of Columbia.

Claim.—"The adjustable perforated blower pipe with perforated collar, as described, arranged with the detachable fire place, the latter having a perforated throat and double funnel ventilator, together with the valves, diaphragms, partitions, smoke conduit pipes, as constructed and arranged with the recess casings, forming air chambers and gas receiving apartments."

21. For an *Improvement in Machines for Making Candles;* J. Stainthorp, Buffalo, N. Y.

Claim.—"1st, The employment of the pistons, formed at their upper moulds for the tips of candles, in combination with stationary candle moulds, to throw out the candles in a vertical direction. 2d, The combination of the rack, tip bar, and clasps."

22. For an *Improvement in the Mode of Constructing Saw Plates, and Setting Teeth therein;* Linus Stewart, Washington, D. C.

Claim.—"The improved mode of constructing saw plate, and fastening of the bits therein; that is, the bits shall be so made and arranged with projections on each side equal to the set of the saw, and fastened therein with a key or other known modes of securing the same."

23. For an *Improvement in Machines for Stuffing Horse Collars;* W. L. Whittaker, Cumberland, Maryland.

Claim.—"In combination with the hoppers, the weighted racks for bringing down a regulated quantity of straw to take the place of that carried into the collars by the stuffing rods. Also, stuffing the collar simultaneously from both ends by means of stuffing rods which travel past each other at the centre of the collar, by which means the straw is evenly lapped at the centre as at the ends."

24. For an *Improved Arrangement of Exhaust Pipes in Locomotive Engines;* John Williams, Dunkirk, New York.

Claim.—"Surrounding the exhaust pipes with cylinders, the outer one connected by wings with the sides of the smoke arch, for the purpose of economizing fuel and power of the engine, as well as equalizing the draft through the lower flues of the boiler."

25. For an *Improved Mode of Extracting Stumps;* W. W. Willis, Orange, Mass.

Claim.—"The combination of the draft hook, shears, and pulley."

26. For an *Improvement in the Arrangement of Desks in School Rooms;* V. Woodcock, Swanzey, New Hampshire.

Claim.—"The diagonal arrangements of the seats and desks."

27. For an *Improvement in Apparatus for Purifying Illuminating Gas;* Dexter H. Chamberlain, West Roxbury, Assignor to Henry Woodward, Boston, Mass.

Claim.—"An improved gas purifying apparatus, the closed cistern, and made to distribute gas in contact with the liquid therein, and to be put in rotation by the gas, so as to stir up and agitate the said liquid, as specified; the said apparatus consisting of a wooden or other proper float, and a separate gas receiving and discharging apparatus, composed of the disk, the tube, and its receiving and discharging scroll, or the equivalent therefor; such a mode of constructing the agitator having important advantages over a simple float having an annular chamber formed within it, and made while resting on a purifying liquid to receive gas and to be raised by it, and so as to permit it to escape in numerous thin streams, and over in contact with the liquid."

28. For an *Improvement in Grain and Grass Harvesters;* John H. Manny, Rockford, Illinois, and Henry Marcellus, Amsterdam, New York.

Claim.—"Supporting the stalks of grass or grain to be cut, by means of rods or wires on one side of the sickle, while they are supported on the opposite side by means of the edges of the fingers in the usual way. Also, the construction of the shanks or near part of the fingers in such form that the shanks will pass or overlap each other, and mutually support each other and stiffen the finger bar. Also, the manner of connecting the rods to the fingers and to the cutter bar, and of adjusting them so as to support and brace the point of the finger with such degree of force as may be required."

MARCH 13.

29. For an *Improved Sash Fastener;* Wm. E. Arnold, Rochester, New York.

Claim.—"The arrangement of the bolt traversing in guides, the slide and the tumbler, in relation to the case, and the notches thereon."

30. For an *Improvement in Bottle Stopper Fastenings;* T. A. Ashburner, Phila., Pa.

Claim.—"The device herein described, for securing corks in bottles, viz: a button provided with hinged stirrups for catching under the projection of the bottle, for the purpose of more readily placing it on or removing it from the cork; and this I claim, whether said device is a fixture on the bottle, or separate therefrom."

31. For a *Polishing Apparatus for Watch Makers' Lathes;* J. M. Bottum, City of N. Y.

Claim.—"The application of the polishing spindle to the lathe, in such a manner that it has a universal movement, for the purpose of adjusting the polishing wheel to surfaces of various forms."

32. For *Improvements in Machines for Turning, Boring, and Slotting Metals;* Alanson Brown, Rochester, New York.

Claim.—"So arranging the table or face plate, and upper spindle or tool holder, on a machine for turning, boring, and cutting key seats, as that either one of the two may be revolved, and the other remain stationary, as the character of the work may require. Also, combining with the upper spindle a revolving slide head carrying a cutter susceptible of either a horizontal or vertical motion or adjustment, for the purpose of turning off work either inside or outside that will not revolve between the columns. Also, the arranging of the two, three, or more supporting columns, in rear of a plane drawn through the line of centres of the operative parts of the machine, for the purpose of leaving an unobstructed front for the introduction of the piece to be dressed."

33. For an *Improvement in Self-Loading Carts;* Ze Butt, Lincolnton, N. Carolina.

Claim.—"The manner of constructing, arranging, combining, and operating cart bodies, so that they can be dropped to or upon the ground to receive the load, be loaded as the cart moves forward, and then elevated, and dumped or unloaded the same as an ordinary cart."

34. For an *Improvement in Excluding Dirt from Grooved Railroad Rails;* C. M. Eakin, Philadelphia, Pennsylvania.

Claim.—"The application of an elastic filling to the groove which is formed in the track to receive the flanches of the wheels."

35. For an *Improvement in Hoop Jacks for Sailing Vessels;* E. Foster, Fairton, N. J.

Claim.—"The arrangement of the hoop jack with the lower halyard block, the brace line, clevis and gaft hook; clevis and hoop line extending down to the foot of the mast, and connected to each sail hoop."

36. For *Improvements in Cut-off Valves for Steam Engines;* Noble T. Greene, Bridgeport, Connecticut.

Claim.—"Combining with the rocking levers, or their equivalents for operating the valves, the spring tappets on the sliding bars. Also, in combination with the sliding spring tappets that operate the rock levers, the employment of the gauge bar, or any equivalent therefor, to regulate the period of closing the valves, whether the said gauge bar be regulated by a governor, or by other means."

37. For an *Improvement in Seed Planters;* H. Ludington and S. R. Lupton, Addison, Pennsylvania.

Claim.—"The construction of an expanding sectional hopper, hung by hinges, or otherwise pendent, and formed with concaves on the inner side, which concaves have formed thereon diagonally arranged ridges or sloping irregularities. Also, the construction of a drum, cylinder, or roller, with series of ridges or sloping irregularities formed or arranged diagonally across its circumference or periphery, together with longitudinal troughs or gutters, at intervals between the ridges; this cylinder being also combined in action or operation with the hopper and the revolving spike shaft. Also, constructing a feeding or supply fountain, having the combination of adjustable hinged frame grating, actuated by cords or equivalents, and to answer the two-fold purpose of holding the

compost mass, and preventing the escape of lumps, &c., &c., and admitting also of being elevated or depressed, or thrown forward at pleasure, for the purpose of relieving the grating and hopper or fountain of lumps and other obstructions."

38. For an *Improvement in Gas Regulators;* J. W. Hoard, Providence, R. Island.

Claim.—"The arrangement of the inverted cup, so that only the upper side or exterior is exposed to the pressure of the gas, and the under side or interior is exposed to the atmosphere, when this is combined with the application to the said cup of the air spring, or its equivalent."

39. For an *Improvement in Screw Wrenches;* Joseph Hyde, City of New York.

Claim.—"The auxiliary jaw or 'gripper,' applied to or inserted within either the stationary or movable jaw of a hand or screw wrench, said jaw or gripper being constructed and arranged as herein shown, or in an equivalent way, so as to bind or press the article between it and the stationary jaw, with a force proportionate to that exerted in turning the wrench."

40. For a *Machine for Making Paper Boxes;* Louis Koch, City of New York.

Claim.—"1st, The application of a series of rollers connected together and worked by an arrangement of levers and toes or cams, for the purpose of bringing paper from an endless roll and of a required length into the machine, and pieces of paper previously shaped and pasted by the machine to the place required. 2d, The application of a stamp frame with suitable knives or stamps attached, situated between the rollers, for the purpose of cutting off the paper the required size and shape from the endless roll necessary for one box. 3d, The application and construction of the pasting frame, with paste boxes situated between the rollers, and arranged in such a manner as to paste the already shaped paper in the required places. 4th, The construction and application of a wheel with arms, having at their extremity the moulds attached, around which the boxes are to be made, said wheel with moulds being moved by an arrangement of a rod and lever actuated by a cam. 5th, The application and use of a series of slides, for the purpose of folding the ends of the paper round the mould, said slides being worked by a combination of levers, &c., actuated by toes. 6th, The application and use of a pair of pincers, for the purpose of pulling the finished paper box off the mould. 7th, The construction of the outer mould, formed by two projections attached to the frames, and a hinge valve, and the operation and manner of working said valve."

41. For an *Improved Grain Cleaner;* George Leach, Owego, New York.

Claim.—"Dressing or furrowing the stones by having the furrows or grooves cut in the face of the bed stone, and the furrows or grooves in the face of the runner."

42. For an *Improvement in Sleighs;* Wm. W. Gruivits, Rodgersville, New York.

Claim.—"The combination of the sliding bolsters and friction rollers with the axle-tree and fixed bolsters. Also, the slots in the cross bar, which permit the movement of the forward runners without any wrenching."

43. For an *Improved Ditching Machine;* Robt. C. Mauck, Harrisonburg, Va.

Claim.—"The mode of regulating the operation of the cutter or plough, by means of the swinging frame connected with the body of the machine, in connexion with the check plates."

44. For *Improved Valves for Gas Burners;* Andrew Mayer, Philadelphia, Penna.

Claim.—"Fitting the valve cups to a tube which forms a valve box in which all the cups and valves can be properly fitted without difficulty, and inserted conveniently in their place in the burner, or into any chamber prepared to receive them."

45. For an *Improved Evaporating Apparatus;* James McCracken, Bloomfield, N. J.

Claim.—"The arrangement and use of a set of metallic cylinders containing vertical tubes, in connexion with the mode of conveying the escape steam from the pans to the condenser."

46. For a *Method of Operating Pumps by Wind;* H. Moore, Charleston, Michigan.

Claim.—"The combination of a compensating cam and spring, or the equivalent thereof, for operating a pump driven by a wind-mill."

47. For an *Improvement in Washing Machines;* Elijah Morgan, Morgantown, Va.

Claim.—"Suspending a reciprocating rubber between the yielding bar and wash board, in such manner that said wash board and bar may both have a vertical motion

during the action of the rubber, and at the same time an expansive action or motion due to an over accumulation of the clothes between the rubber and the wash board."

48. For an *Improvement in Fire Extinguishing Compositions;* Edward F. Overdeer, Chattanooga, Tennessee.

Claim.—"The employment of a solution of pearl ash in water, in the proportion of 16 pounds of pearl ash, or thereabout, to 100 gallons of water, as a substitute for water in extinguishing fires."

49. For an *Improvement in Lamps;* Frederick C. Rider, Providence, Rhode Island.

Claim.—"The use of the regulator tube, arranged and operated in combination with the wick and wick holder, as applied to the inner surface of the wick to regulate and control the flame of the wick."

50. For an *Improvement in Brick Kilns;* Jesse Russel, Elkton, Kentucky.

Claim.—"The arranging of the fire chambers outside of the kiln, and introducing the products of combustion to the brick to be burnt through avenues or passages extending from the fire chambers entirely across the kiln, when said fires are placed and used on one side of the kiln only."

51. For an *Improvement in Ordnance;* Christopher Wolter, Bridgeport, Conn.

Claim.—"1st, The connexion of two barrels or pieces, mounted in such a manner that they may be adjusted and held at any desirable angle relatively to each other. 2d, The connexion of the barrels by means of the toggle joints, and the central slider working in a suitable slide supported by the carriage, for the purpose of adjusting the barrels at the desired angle. 3d, Supporting the breeches for the purpose of varying the elevation of the barrels by means of a frame composed of sectors, and slotted heads attached thereto, as described, whereby the necessary changes of elevation, and of the angle of the two barrels are provided for, independently of each other; this I claim, irrespective of any mechanical devices that may be employed to raise and lower the frame. 4th, The connexion of the two hammers or the triggers, or their equivalents, by means of two links with a sliding piece, operated upon by a cord or chain connected with a rod which passes through the side of the carriage and has a spring applied. 5th, Connecting the cord or chain with the rod, or its equivalent, by merely passing it through an eye at the end thereof, and attaching it to a winch conveniently situated, to keep it always wound up to the proper degree to give it the required length."

52. For an *Improved Safety Ferry Bridge;* Henry Lawrence, City of New York.

Claim.—"The employment of the reciprocating carriage, the suspended central gate, and side gates, the whole being operated by the boat and weights. Also, making the side gates of a circular form instead of flat, so that in case drunken or thoughtless men lay hold of them, or get in a position to interfere with their being opened freely, they shall, as they open, have a tendency to throw them off, instead of forcing them up against the railings and crushing them."

53. For an *Improvement in Curtain Rollers;* Frederick W. Urann, Saxonville, Mass.

Claim.—"The improvement of extending the pulley head into the bracket, for the purpose of protecting the cord of the pulley from getting between the said head and the bracket during the process of rolling up or unrolling the curtain."

54. For an *Improvement in Stump Machines;* Edward Vaughn, Alliance, Ohio.

Claim.—"The arch beams. The brace posts, in combination with the incline braces and horizontal beams, making a new and useful, firm, and compact frame. Also, the combination of a half sphere and groove, forming a new half spherical washer. Also, the combination of the groove opening with a square recess. Also, for the purpose of attaching and detaching the trucks to and from sills, by the combination of levers, fulcrums, joints, posts, dogs, and levers. Also, the securing of the bar to the hounds. I do not claim any one separate thing in the above mentioned invention, but do claim the combinations."

55. For an *Improvement in Door Locks;* Wm. Warwick, Birmingham, Pa.

Claim.—"The so forming of the tumblers with beveled edges for the key to operate it, and so arranging it in relation to the bolt and the stud, that when locked the bolt is held firm against pressure, by the tumbler fitting over the stud."

56. For an *Improvement in Eaves Gutters of Houses;* George W. Wheatly, Harrodsburgh, Kentucky.

Claim.—"The application of a bead or moulding, together with a strop, to gutters, giving strength to the gutter without the aid of a plank, or other substance."

57. For an *Improvement in Breech Loading Fire Arms;* R. White, Hartford, Conn.

Claim.—"The connexion of the breech with the hammer, in such a manner that it may be withdrawn to open the chamber to receive the charge by the act of cocking the hammer, and replaced to close the chamber by the falling of the hammer when the latter is set free to explode the charge."

58. For an *Improvement in Breech Loading Fire-Arms;* R. White, Hartford, Conn.

Claim.—"1st, The connexion of the breech or breech-piece with the hammer, in such a manner that the latter may be cocked by the act of moving the former into its place to close the chamber. 2d, The peculiar manner of effecting the cocking and setting free of the hammer by means of the spring tooth attached to the breech or breech piece, and the sliding piece working in the tumbler to be acted upon by the trigger, for the purpose of disengaging the said tooth. 3d, The employment of a crank or eccentric, for the purpose of disengaging the tooth from the tumbler, and thereby disconnecting the hammer from the breech or breech-piece, when the immediate repetition of the discharge is not desired."

59. For an *Improvement in Processes of Curing Meats;* J. C. Schooley, Cincinnati, O.

Claim.—"The process of curing meat and preserving fruit and provisions by means of circulating currents of air artificially dried by ice, or its equivalent, through the room wherein the curing takes place."

60. For an *Improvement in the Manufacture of Stone Paste Boards;* James Smith, Mendon, New York.

Claim.—"Sheets for roofing, boarding, and other purposes, made or constructed by combining said stone, when pulverized, with paper pulp, and I also claim the application of and combining drying oil with said pulverized stone and paper pulp combined in sheets, as aforesaid."

61. For an *Improvement in Machinery for Spinning Wool;* Frederick S. Stoddard, Litchfield, Connecticut.

Claim.—"1st, Conducting the roving from the back to the front drawing roller, by employing a bridge or rest, with fingers upon it, situated between the front and back pairs of drawing rollers, for the purpose of governing the counter twist so as to adapt a smaller portion of it to the part of the thread nearest the back rollers. 2d, Impeding the ring travelers while winding upon the lower or larger parts of the cones, by means of a series of brushes, or their equivalents, operating substantially as set forth, so as to gradually set the travelers free as the winding approaches the smaller or upper ends of the cones, thereby producing a uniform tension on the thread while winding."

62. For an *Improvement in Air-Heating Furnace;* James H. Sutton, Honesdale, Pa.

Claim.—"The arrangement of the furnaces, the descending smoke pipes, and the central smoke pipe, with each other and with the single air heating chamber."

63. For an *Improved Apparatus for Operating Ventilators;* Isaac P. Trimble, Livingston, New York.

Claim.—"Having the valves or ventilating doors connected to the said metal bands, about midway between their fixed supports, so that the varying degrees of flexure shall effect the operation of opening or closing said doors."

64. For an *Improvement in Benzole Vapor Apparatus;* Chas. Cunningham, Nashua, New Hampshire, Assignor to John C. Pedrick, Boston, Massachusetts.

Claim.—"1st, The combination of the heater and the swinging gas burner, or of the induction air pipe and any one of the burners of the apparatus, with the water vessel, the reservoir, or the metre, for the purpose of keeping the contents of the vessel containing the benzole or light producing liquid, at a given temperature. 2d, The combination of the reservoir and the rotary disseminator with an ordinary rotary metre wheel, for forcing air through the hollow shaft, or its equivalent, into the reservoir, for the purpose of vaporizing the benzole of the latter vessel. 3d, The particular mode of making the

rotary disseminator. 4th, The application and use of the metre with its case and contents, as an air blast apparatus, operated by weights or otherwise."

65. For an *Improvement in Cultivators;* Sam. A. Knox, Assignor to Ruggles, Nourse, Mason & Co., Worcester, Massachusetts.

Claim.—"Arranging the curved knife or pointed tooth at or near the front end of the beam of the horse hoe, while the main or double hoe is disposed at or near the rear end of the beam, and so as to enable the said tooth to be used in manner and for the purposes as stated, it being employed in a common plough simply for cutting the sod or opening it for the reception of the nose of the plough."

MARCH 20.

66. For an *Improvement in Folding Life Boats;* Edward L. Berthon, Fareham, England; patented in England, June 12th, 1851.

Claim.—"Hinging longitudinal ribs of the two sides to the stem and the stern posts, in such manner that those ribs shall be capable of being folded down, and shall lie parallel with the keel when the boat is collapsed."

67. For an *Improved Swivel for Watch Chains;* Elihu Bliss, Newark, N. Jersey.

Claim.—"The specific arrangement of the joint of the swivel."

68. For an *Improved Wagon Brake;* J. E. Blodgett, Oswego, New York.

Claim.—"The application of wagon brakes to the forward wheels of wagons, by using the hounds, sway-bar, block tongue, or other appendages running back from, and firmly attached to the front axle, as the frame for the support and steadying of such brakes; also, the construction of a brake so light and simple as to admit of being supported by such frame, such brake having a main bar of sufficient length to receive both pads, said main bar turning upon its fastening at or near its centre, with the pad for one wheel firmly attached to one end, and the pad for the other wheel so attached to the other end of the main bar as to turn on such attachment or fastening, such turning pad to be of such form as to bear against its wheel on being turned partly round, and to bear harder on being turned further, and at the same time, by crowding back that end of the main bar to which it is attached, to throw the other end with its pad against the other wheel."

69. For an *Improvement in Knobs for Fastening Curtains, and other like Purposes;* W. Z., W., and J. W. Chapman, City of New York.

Claim.—"The combination of the eyelet, or its equivalent, with a shank or knob of metal, or other material that is covered, capped, encircled, or so connected with india rubber, or the equivalent thereof, that by its elastic nature the said eyelet may be secured to it."

70. For a *Method of Self-Ventilation for Railroad Cars;* V. P. Corbett, Corbettsville, New York.

Claim.—"Forming a series of ventilating holes in the sides of the car between the ceiling and windows, and providing in said holes vertical ventilating fans, which are arranged so as to be caused to revolve by the rapid moving of the car through the atmosphere, and thus made to exhaust the impure air from the inside of the car."

71. For a *Device for Air Chamber Pumps;* John P. Cowing, Seneca Falls, N. York.

Claim.—"The combination and arrangement with the air chamber or vessel of the pump, having its delivery spout or outlet below, or at or near the bottom of said chamber, of a hand air valve or perforated nut at or near the top of the air vessel, for the conversion by hand with facility and despatch, of the close air vessel into an open water reservoir, or vice versa, above the discharge outlet or spout, and whereby the uses of the common well or lift pump may be varied with despatch, and its convenience augmented."

72. For a *Machine for Cutting Barrel Heads;* A. H. Crozier, Oswego, New York.

Claim.—"1st, Arranging and operating two rotating cutters so as to cut scores in the opposite sides of the rotated heading at the same time, one cutter being arranged and operated so far in advance of the other that the latter cutter may cut so far into the heading and into the score made by the former without interfering with it, (the first cutter,) as to sever the superfluous portions of the heading from the head, at the same

time that they cut it circular, and bevel or form the edge to fit the croze in the cask. 2d, Traversing or vibrating the clamp edgwise, after the heading is placed in it, to bring the heading in contact with the cutters, and to remove the head from the cutters after it is formed, so as to take it out of the clamp, and insert material to form another head and bring it into contact with the cutters without stopping them (the cutters,) during the operation or time occupied in making the change. 3d, The revolving clamp, in combination with the rotating cutters."

73. For a *Pump;* Charles G. Curtis, Springfield, Massachusetts.

Claim.—"Arranging the eduction and induction valve chambers concentrically around the upper end of the pump barrel, and with respect to one another, they being provided with valves and passages connecting them together, and with the two ends of the pump barrel, the said arrangement admitting one cap plate to be employed both for the valve case and the pump barrel, and at the upper end of said pump barrel."

74. For an *Improved Shot Cartridge;* Abbot R. Davis, East Cambridge, Mass.

Claim.—"An improved shot cartridge, made by mixing the shot in a plastic material or compound, subsequently reducing the mass to the shape required for the cartridge, and covering its external surface with fibres of wool or other material, felted or applied thereto."

75. For an *Improvement in Feeding Fuel to Furnaces;* H. Delano, Syracuse, N. Y.

Claim.—"The combined use of the feed box and grate bars or cut-off, for feeding in fuel into the under part of the burning mass in the fire box, or their mechanical equivalents. Also, the combination of the crank shaft, slotted piece, lever, and trigger, or their mechanical equivalents, for sliding the feed box and grate and cut-off, and for raising and lowering the bottom of the feed box."

76. For an *Improvement in Rakes and Elevators;* Alexander H. Gaston and Joseph Smith, Sunbury, Ohio.

Claim.—"The endless belts and rakes, in combination with the rollers and revolving forks, for the purpose of raking and loading hay."

77. For an *Improvement in Extension Tables;* Joel Haines, West Middlebury, Ohio.

Claim.—"The construction and arrangement of the top so as to wind up in the case."

78. For a *Valve for Hydraulic Rams;* Thomas Hanson, City of New York.

Claim.—"The mode of forming the connexion between the driving chambers and air vessels of water rams, the tube and flexible cup placed within it."

79. For an *Improvement in Lamps;* Elbridge Harris, Boston, Massachusetts.

Claim.—"Using within glass lamps of any form, reservoirs of metal which are provided with the usual tubes for burning common oils, or adapted by means of protectors to burn any fluid combustible. Also, the mode of ornamenting such reservoirs contained within glass, by means of paper with metal or ornamental surfaces."

80. For *Ship Augers, &c.;* Isaac W. Hoagland, Jersey City, New Jersey.

Claim.—"Attaching the cutting portion of the auger to the screw portion, as herein shown and described, viz: by means of the dove-tail notch formed by the shoulder and inclined end, dowel, and screw."

81. For an *Improvement in Railroad Car Brakes;* Gideon Hotchkiss, Windsor, N. Y.

Claim.—"The method of operating a railroad car brake by obtaining leverage from the axles and boxes by means of the bridges, keys, and clutches, or their equivalents."

82. For an *Improved Hand Press for Printing;* Chas. Keniston, Boston, Mass.

Claim.—"The arrangement and construction of the press, as herein described; that is to say, there is an extended arm on which a piston and type are attached, the same operating upon a swivel, the whole being attached to a solid bed. There are two pads attached to said bed, one for the purpose of inking the type, the other for the article to be placed on when printing. The operator, by turning said arm over the pads, and striking a light blow upon the top of the piston, alternately will ink and print with the accuracy that no other press has done."

83. For an *Improvement in Seed Planters;* Ebenezer Morse, Walpole, N. Hampshire.

Claim.—"The scrapers, the cam and sliding back board, as arranged, combined, and operating conjointly with the seed box, for the purpose of depositing seed in hills, covering it with earth, and pressing the earth upon the seed. Also, the oscillating motion of the horizontal handle, connected to the front and back part of the seed box by a hinge joint at each end of the handle."

84. For an *Improvement in Fire Arms;* Frederick Newbury, Albany, New York.

Claim.—"The ratchet plate with its ratchet indentations and its slot, in combination with the pin by which it connects the cylinder. Also, the two stop levers below the cylinder to regulate and secure the connexion between the chambers of the cylinder and the barrel. Also, the arrangement and combination of the tumbler with the hammer and cocking spring, to enable the hammer to act independently of the tumbler in the act of firing. Also, the arrangement of the hammer to lie within the stock, and to act in such line of direction upon the nipple as to press and hold the cylinder firmly against the barrel in the act of firing. Also, the arrangements of the apparatus for disengaging and attaching the barrel with the cylinder to the stock, viz: the thumb connecting plate or detent, with the spring to hold it in place, and the notch in the mandrel to receive the detent."

85. For an *Improvement in Cartridges;* Abner N. Newton, Richmond, Indiana.

Claim.—"The arrangement of the percussion priming with a metallic rod, whereby said priming is ignited within the chamber of the gun between the ends of two metallic rods."

86. For an *Improvement in Seed Planters;* Daniel H. Phillips, Greenville, Illinois.

Claim.—"1st, The employment of a spring lever to open and close the seed slide in such a manner that while it serves to open the slide by the direct action of the revolving wheel or roller, as specified, the same lever, by its elasticity, closes the slide after the discharge has been made. 2d, Providing both ends of the carrying and leveling roller which operates the seed slide lever, with cogs or projections, so arranged that by reversing the roller, as described, a slower or quicker movement is given to the delivery slide, according to the description of grain to be planted."

87. For an *Improvement in the Manufacture of Bricks;* L. E. Ransom, Havana, O.

Claim.—"The manufacture of bricks by first spreading the tempered mortar or clay at once upon the ground where the bricks will be left to dry, and in beds of certain desired length, width, and thickness, and then while the mortar is in a soft state, or before it shall crack by too much drying, producing therein lines of weakening or separation, defining the dimensions of the bricks without regard to their smoothness or final finish, and after the bricks in drying shall have separated from each other along the lines thus formed, turning them on edge, and squaring and polishing their edges, and defining the thickness of the same by rubbing over them the metallic tool, or otherwise, the desired thickness of the bed being produced by means of guide bars or moulds, and scraper or lute, whereby I am enabled to dispense with off-bearers, and otherwise to simplify the manufacture of bricks."

88. For an *Improvement in Mowing Machines;* Fisk Russell, Boston, Massachusetts.

Claim.—"Arranging the secondary supporting wheel and the cutter frame in front of the driving shaft, when such driving shaft and the driving wheel are arranged and connected by gears, as specified, the same serving to lessen the side draft or pressure on the horses or draft animals, in comparison to what it would be were the secondary wheel and the cutter frame disposed back of the driving shaft, when arranged with respect to the driving wheel. Also, the combination of two knives so that they shall project in opposite directions from one centre plate or bar, in order that either of the knives may be used in connexion with the guard teeth, and either be made to serve as a lever to the other, whenever circumstances may require."

89. For a *Machine for Polishing Daguerreotype Plates;* D. Shive, Philadelphia, Pa.

Claim.—"The shaft with its arms, cranks, the pieces C and D, or their equivalents, and the eccentric, with its spur wheel, in combination with the united spur wheels."

90. For an *Improvement in Seed Planters;* Benj. M. Snell, Hancock, Maryland.

Claim.—"The construction of a plough, wherein a double share is used to open the

soil, in combination with a seeding tube, hopper, and striker of wheel, for the purpose of depositing seed in the prepared soil, without the objection of an open furrow."

91. For an *Improved Self-Loading Cart;* J. A. Sprague and B. O'Connor, Dayton, O.

Claim.—"1st, The combination of a large divided scoop with an ordinary cart. 2d, The angle irons on the under side of the cart shafts near the forward ends."

92. For a *Mortising and Tenoning Machine;* Elihu Street, Montville, Connecticut.

Claim.—"The improvement on a machine for mortising, tenoning, sawing, and smoothing, by combining certain tools together, used by carpenters, in the manufacture of doors, sash, and blinds."

93. For *Improvements in Valve Gearing for Steam Engines;* H. Uhry and H. A. Luttgens, Paterson, New Jersey.

Claim.—"The differential rocker, in connexion with the stationary or shifting link motion, for the purposes of increasing the opening of the steam ports at the higher grades of expansion, and retarding and varying the time of exhaust without incurring early compression attending increase of inside lap on an ordinary valve. Also, the duplicate valve seats, being arranged parallel to each other, provided with steam ports and an exhaust port; the two steam ports towards the front of the cylinder joining in one passage, lead the steam to that end of the cylinder, the other two steam ports leading the steam into one passage towards the back end of the cylinder."

94. For an *Improvement in Looms;* Lewis Van Riper, Spring Valley, New York.

Claim.—"1st, Intertwining the warp threads in the manufacture of gauze fabrics, by the employment of needles having a compound motion. 2d, Constructing the needles for working the warps with flat, or thin and crooked ends. 3d, The arrangement of the needles in two series, and giving to one or both series a compound lateral and longitudinal motion, to intertwist the threads which the two carry, and at the same time open a shed for the insertion of the weft thread. 4th, The method of working the needles so as to cause them to raise and lower and intertwine the warps alternately, with simply raising and lowering them, to adapt them to weaving gauze and plain fabrics alternately. 5th, The combination of the needles and heddles operating automatically, so as to form a web of reticulated bars or strips of plain fabric with the spaces between the bars or strips filled with wire gauze. 6th, The combination of the yielding reed, the lever, with the pin on its lower end, the pin on the sword of the lay, the ratchet lever, with its double inclined planes, for the pin to act upon, and the ratchet wheel with the cloth beam, for the purpose of winding up the woven fabric at a variable rate. 7th, The combination of the mechanism for winding up the woven cloth with the cam, and the intermediate devices, for the purpose of effecting the requisite changes in the variable cam. 8th, The variable cam, for the purpose of changing the operation of the needles to adapt them to weaving plain and gauze fabric alternately."

95. For *Pumps;* William T. Vose, Newtonville, Massachusetts.

Claim.—"Connecting the two pump barrels at two adjacent ends, in combination with not only arranging the valves of their respective pistons so that one of them shall be applied to one or the upper side of one piston, while the other is applied to the opposite or lower side of the other piston, as stated, but applying the eduction and induction pipes respectively to the disconnected ends of the barrels."

96. For an *Improvement in Breech Loading Fire Arms;* Alex'r. T. Watson, Castleton, New Jersey.

Claim.—"The mechanical combination and arrangement of the cylinder, the bent lever, and the forked standard, acted upon by the rod and spiral spring; also, the spring, by which, being drawn back, the cartridge is released from the pressure, and the cylinder is made to pass over the next succeeding cartridge, and the pressure of the finger being removed from the rod, the cartridge is firmly griped and carried forward towards the chamber by the action of the rod and spring, pushing before it also the next preceding cartridge ready to be deposited in the chamber upon the raising of the breech piece, which operation being repeated after each discharge, in connexion with raising the breech piece, secures a measured supply of charges from the magazine in the stock to the chamber, to an extent and with a facility not heretofore attained in breech loading fire arms. Also, the forming of the breech piece of a segment of a circle, having the concave space for the bottom of the chamber with its central point of depression in the

line of the axis of the barrel. Also, the forming the lower end of the breech piece into two cutters, one front, the other back, with the rounded swell between, operating as well to hold the cartridge in its place as to cut off the end, and remove the parts thus cut off."

97. For an *Improved Printing Press;* Lemuel T. Wells, Cincinnati, Ohio.

Claim.—"The platen, hinged or pivoted to vibrating arms, in combination with the stationary pin or pins, and retracting springs, or equivalent devices."

98. For *Centrifugal Water Wheels;* Oscar Willis, Dizardville, North Carolina.

Claim.—"1st, The peculiar double curved buckets, in combination with the beveled rim and hub, (or nut.) 2d, Ranging the top of the bucket on a line tangential to a circle of suitable diameter described around the centre, its inner being in advance of the radial line. 3d, Forming the annular water space on the upper side of the wheel."

99. For an *Improvement in Grain and Grass Harvesters;* Walter A. Wood, Hoosick Falls, New York.

Claim.—"Making the inner face of the supporting wheel conical, for the purpose of clearing the track for the next or return swath of the machine. Also, the forming of a quadrangular space on the platform between the end of the cutting point and the frame of the machine, sufficient to hold as much grain as will make a bundle or sheaf, before it is raked from the machine."

100. For an *Improvement in Cultivators;* Geo. W. N. Yost, Port Gibson, Miss.

Claim.—"The combination of the adjustable scraper with the bar, point, &c., for the purpose of baring off the row and rapping up the middle; also, for scraping off the row and rolling the scrapings over into the furrow opened by the plough."

101. For an *Improvement in the Arrangement of Wheels, Axles, and Friction Rollers;* George A. Prentiss, Cheshire County, New Hampshire.

Claim.—"The combination of the following elements, viz: a load axle with a bearer secured thereto, a securing axle, concentric therewith, or nearly so, and a ring or series of friction rollers, the whole being applied to a pair of wheels."

102. For an *Improvement in Sewing Machines;* Geo. W. Stedman, Vienna, N. J.

Claim.—"Feeding the cloth along by means of the needle acting as a lever against it over a fulcrum, the needle carrier being driven for the purpose with a crank motion, or its equivalent. Also, regulating the length of the stitch by the combined action of the slot, of adjustable length, and the slight spring, or its equivalent, for throwing the needle away from the fulcrum when disengaged from the cloth. Also, the construction of the finger with a thin pointed beak for entering the loop, with a wedge-shaped shoulder for spreading the loop open to receive the needle in turn, and with a spring for retarding the motion of the loop, arranged and operating in combination with the needle."

103. For an *Improved Press for Making Cylindro-Conical Hollow Projectiles by Pressure;* Wm. M. B. Hartley, City of New York.

Claim.—"The collar, in combination with the sectional parts of the die. Also, the arrangement, relative to the punches, of the die, with a horizontal motion of sufficient amplitude to admit of the successive action of the punches. Further, the ball while in its die, and while held firmly at its base by a punch, which punch, on the opening of the sections, will, by a subsequent or continuous motion, discharge the ball capped and ready for use."

104. For an *Improvement in Attaching Augers to Handles;* Chas. W. Cotton, Shelburne Falls, Massachusetts.

Claim.—"Attaching or securing augers to handles, by having a metallic tube placed around the centre of the handle, and having a transverse rectangular taper hole made through the handle and tube, and a metallic band placed around the tube, and turning loosely thereon, said band having slots made through it, a part of the slot being of taper form. The shank of the auger being placed in the hole and through the slots in the band, and secured in the handle by turning said band and causing the edges of the taper portion of the slot to pass in the notches or recesses in the shank."

105. For an *Improvement in Ore Separators;* Reuben Shaler, Madison, Connecticut.

Claim.—"The combination of mechanism which separates the fine earth and small particles of gold from the coarse, and exposes the finer portion of impurities and gold to

a moderate blast, and the coarser portion to a more powerful blast. The said combination embraces the blower, which produces two blasts of unequal force, the two sets of shelves or inclined planes, and the screen, or its equivalent."

106. For an *Improvement in Sewing Machines;* Thomas J. W. Robertson, Assignor to self and Alfred E. Beach, City of New York.

Claim.—"The combination of the spring clamp with the feeding bar or dog, constructed, arranged, and operating together against the cloth, on its one side or surface."

107. For an *Improvement in Casters for Furniture;* Gilbert L. Bailey, Assignor to self and Mighill Nutting, Portland, Maine.

Claim.—"The pin or oval guide put through or applied to the spindle in any manner, or its equivalent, and attached to a straight truck frame, with a socket hole larger than the spindle."

MARCH 27.

108. For a *Rotary Pump;* Abel Barker, Honesdale, Pennsylvania.

Claim.—"Causing the buckets, during a portion of their revolution, to pass through an inclosed channel, and, during the remainder of their revolution, to pass through the chamber which communicates directly with the central induction opening."

109. For a *Clamp and Mouth-Piece for Lumber Jointing Machines;* Chas. F. Bauersfeld, Cincinnati, Ohio.

Claim.—"1st, Two or more clamps, so arranged and connected as to be simultaneously and equally applied to or withdrawn from the different parts of a portion of furniture to be jointed, by the means of a single handle. 2d, The parallel motion, fixed in any desired position by means of the bridle and screw."

110. For an *Improvement in Preparing Woolen Roving;* Augustus E. Bigelow, Chicopee, Massachusetts.

Claim.—"The mode of operation of spinning woolen yarns from previously twisted rovings, by drawing the twisted roving between two sets of draw rollers, in combination with the subsequent twisting in the same direction by ring groove travelers, flyers, or other equivalent devices."

111. For an *Improvement in Spinning Wool;* Augustus E. Bigelow, Chicopee, Mass.

Claim.—"The combination of flyers, or the equivalents thereof, and their appendages, with the ring doffer or doffers of a carding machine, by the interposition of a pair or pairs of rollers, to deliver the slivers from the doffer or doffers, that they may be regularly twisted and wound on without drawing."

112. For an *Improvement in Machines for Turning the Lips of Augers;* Ransom Cook, Shelburne Falls, Massachusetts.

Claim.—"The combination of the screw shaft, or its equivalent, with the wrench, and crimping or clamping dies. Also, the shape of the wrench, for the purpose of turning the lips of boring implements."

113. For *Improvements in Grain and Grass Harvesters;* Andrew Dietz and John G. Dunham, Raritan, New Jersey; ante-dated January 2, 1855.

Claim.—"1st, Constructing the cams upon the driving wheel of a length exactly corresponding to the cutting range of a single stroke of the knife during the advance and return of the cutter bar. 2d, The difference in the relative depths of the cams, in combination with the linked levers. 3d, Arranging the highest elevation of each cam upon the wheel at a point between the highest elevation and lowest depression of a cam upon the other side of the wheel."

114. For an *Improvement in Processes for Refining Jewelers' Scraps;* L. B. Darling, Providence, Rhode Island.

Claim.—"The processes of separating and recovering the gold and silver from goldsmith's and jeweler's scraps, such as turning, sweepings, cuttings, and filings, which contain both noble and base metal, that is, by melting down the metallic compounds, then stirring in gradually the nitre, and working the mass without fluxing, then washing with water and treating with sulphuric acid to convert the oxydized products into sulphates."

115. For an *Improvement in the Combination of Speed and Resistance Governors;* William H. Elliot, Plattsburgh, New York.

Claim.—"The combination of a speed governor with a resistance governor, in such a manner that each shall exert its own proper effect upon the motive power, producing thereby a compound resultant regulation, without either of the said governors interfering with the action of the other."

116. For an *Improvement in Chairs;* Lemuel W. Ferris, Owego, New York.

Claim.—"Hinging the seat, at its back, to the back of the chair, only in combination with hinging the rails of the foot rest to the lower end of the pieces forming the back, so that the seat shall partake of the inclination of the back and foot rest rails, and said foot rest rails move on a changing centre."

117. For an *Improvement in the Mode of Supporting Table Leaves;* Henry A. Frost, Worcester, Massachusetts.

Claim.—"The application to table leaves of a self-acting swing brace or support, which shall operate by its own weight when the leaves are raised."

118. For an *Improvement in Cultivators;* Henry D. Ganse, Freehold, New Jersey.

Claim.—"1st, That shape of the upright parts or fenders, as described, in its application to the purposes described, by which the formost point of each fender is elevated to or above the surface of the ground, and the lower or cutting edge inclines backward from that point, so as to secure the result described. 2d, The combination of said fenders with the mould boards and wheels."

119. For an *Improvement in Screw Wrenches;* L. D. Gilman, Troy, New York.

Claim.—"The arrangement of the adjustable toothed plate with its springs, the toothed shank of the adjustable jaw, and the eccentric with its strap attached to the toothed plate."

120. For an *Improvement in Packing Journal Boxes;* Warner Groat, Troy, N. York.

Claim.—"The combination and arrangement of the packing ring and apparatus for tightening the same within the box, so that the packing in the inner end of the box can be tightened at the end, and the box be kept oil-tight without being pierced with holes."

121. For an *Improvement in Operating Valves in Direct Acting Steam Engines;* W. H. Guild and Wm. F. Garrison, Brooklyn, New York.

Claim.—"Giving to the valve the whole or part of the movement necessary to effect the change in the direction of the engine piston, by means of the steam acting upon a piston which is arranged and applied to work perpendicularly to the valve within a cylinder attached to a cap fitted to the back of the valve, and is supported against the pressure of the steam by a rocker, or its equivalent, by which it is caused to operate."

122. For an *Improvement in Looms;* David S. Harris, Coventry, Rhode Island.

Claim.—"The connexion of the shuttle guard in any way with the belt shipper, that when the loom is in gear the guard may stand over the shuttle race in such a way as to prevent the shuttle flying out of the loom, but when the loom is out of gear, the guard may be raised out of the way of the attendant to enable threads to be picked out or drawn through the reed, or such other manipulations to be performed as may be necessary."

123. For an *Improvement in Fire Proof Safes;* Richard G. Holmes and William H. Butler, City of New York.

Claim.—"Combining with the alum filling an alkali, in such proportions as that the alum, in becoming heated or melted, has a part of its acid neutralized by the action of the alkali, when the said filling is interspersed with and supported or restrained from settling down by cells of porous material, or frame work of porous substance."

124. For an *Improvement in Illuminating Vault Covers;* T. Hyatt, City of N. York.

Claim.—"The method of securing glass in the apertures of metal plates, or other surfaces, by surrounding the glass with a hoop or belt of lead, gutta percha, or other equivalent yielding substance, and forcing the glass so surrounded into the aperture or recess."

125. For an *Improvement in Looms;* Wm. S. Irish, Middlebury, Ohio.

"My improvement consists mainly in its simplicity, dispensing with the use of treadles, cording, strapping, &c., the facility and ease of changing from one species of fabric to another, cheapness of construction, durability, ease of putting up and keeping in order, and requires less power to operate."

Claim.—"The method of raising the harness by the immediate application of the cams to the shoes or projections of the harness."

126. For an *Improved Grate Bar;* J. S. Kirk and W. H. Elliot, Plattsburgh, N. Y.

Claim.—"The employment of a suspension rod for the support of the grate bar, or its equivalent. Also, the constructing of the wearing and supporting parts separately, so that said wearing parts may readily be removed and replaced."

127. For a *Tool for Boring Hubs to receive Boxes;* U. Kimble, Penfield, New York.

Claim.—"The oval-shaped box, with the nut with spurs on the underside resting on the oval-shaped box, in combination with the shaft, the knife, and the gauge."

128. For a *Method of Chalking Lines;* S. B. Knight, North Providence, R. Island.

Claim.—"The method of chalking a line by drawing it through the cylinder, or other vessel containing the fine chalk, and also through the rubber of leather, or other compressible substance, and this I claim, when used for chalk or other coloring material."

129. For a *Shingle Machine;* Chas. Leavitt, Quincy, Illinois.

Claim.—"1st, The elastic table, capable of being elevated and depressed by the means described, or their equivalents, in combination with the froe or splitting knife. 2d, The elastic shingle holder. 3d, The jointing knives, pivoted to the plane stocks, in combination with the bar, for the purpose of jointing the edges of the shingle with a drawing cut."

130. For a *Self-Adjusting or Anchoring Pump;* Thomas Ling, Shelby, Ohio.

Claim.—"1st, Connecting the piston or stationary part to a weight or anchor, by a flexible joint, or its equivalent, so as to allow the anchor to adapt itself to the bottom of the well without cramping the other parts. 2d, Connecting the anchor to the cylinder or moving parts, by means of the projections and slotted arms, or their equivalents, so as to draw the anchor from the well by means of the pipe and cylinder, or moving parts. 3d, The devices, or their equivalents, for guiding and steadying the upper end of the pipe, and discharging the water downwards into a box, having an opening in the side in which the pipe traverses, closed below the pipe by the plate, or its equivalent."

131. For an *Improvement in Charcoal Furnaces;* John McNeill, City of New York.

Claim.—"Supporting the retort tubes by a hollow or tubular beam or beams, with open ends, applied so that one end of each is in communication with the cold atmospheric air outside the furnace, and the other with the chimney or escape flue, whereby a current of cold air is caused to be induced through the beam by the draft of the chimney or flue, for the purpose of keeping it comparatively cool, preventing it burning, and rendering it a firm and durable support to the retort tubes. Also, constructing the furnace with one or more arched walls extending across it, to support the joints in the beams, when the said beams are made in two or more lengths, and also to support the side walls and roof."

132. For an *Improvement in Seed Planters;* Hiram Moore, Climax, Michigan.

Claim.—"Grooved seed distributing wheels, provided at the bottom of the grooves with partitions extending about one-third of their depth, in combination with the dash board."

133. For an *Improved Bill Holder;* Geo. W. Palmer, Boston, Massachusetts.

Claim.—"An oblong box of suitable size, for holding bills or papers, having upon one of its sides a hinged movable arm and attached spring, by which the papers are held in place."

134. For an *Improvement in Coffins;* David Sholl, Cincinnati, Ohio.

Claim.—"The production of a coffin, composed of terra cotta or pottery ware."

135. For a *Current Wheel;* Wm. S. Smith, Cedar Rapids, Iowa.

Claim.—"The construction of current wheels, with heads or hubs movable on the shaft."

136. For an *Improvement in the Manufacture of Boots and Shoes;* Henry G. Tyer and John Helm, New Brunswick, New Jersey.

Claim.—"The uniting of the outer sole and upper, manufactured wholly or in part of vulcanized india rubber, with the insole of boots and shoes, by means of cement, the cement passing through perforations made for the purpose in the upper."

137. For an *Improvement in Seed Planters;* Myron Ward, Owego, New York.

Claim.—"The adjustable slotted share, for the purpose of removing obstructions, and at the same time allowing the fine earth to pass through the slats, which share is made adjustable by means of a thumb screw and plate in rear. Also, the short compressing blocks on the periphery of the wheel, which compressers crowd the earth laterally over the seed, and at the same time indicate the place of the hill, and by which means the grain can be planted in check rows."

138. For an *Improvement in Cultivators;* R. P. Vanhorn, Jackson Town, Ohio.

Claim.—"The peculiar elongated rhombus-shaped wrought iron frame, and arrangement of teeth, the front angle bearing a light steel cutter tooth, and the rear angle a large shovel tooth."

139. For an *Improvement in Pulling Cotton Seeds;* Joseph Walker, Dover, England; patented in England, July 20, 1850.

Claim.—"Supporting and adjusting the concave bed by means of grooves cut within, or other equivalent devices, affixed to the side frame in such manner that the said concave shall be eccentric to the axis of the hulling cylinder."

140. For an *Improvement in Cultivators;* Wm. P. Zane, Woolwich, New Jersey.

Claim.—"The vine hooks, arranged in such a manner in relation to the cultivating teeth, that the said hooks will remove the vines out of the way of the said cultivating teeth, and allow them to operate upon the soil without injury to the vines."

141. For an *Improvement in Processes for Making Kerosene;* Abraham Gesner, Williamsburgh, New York, Assignor to the "Asphalte Mining and Kerosene Gas Co.," City of New York.

Claim.—"The process for extracting the liquid hydro-carbon, which I have denominated 'Kerosene,' from asphaltum, bitumen, asphaltic and bituminous rocks and shales, petroleum, and maltha, by subjecting any of these substances to dry distillation, rectifying the distillate, by treating it with acid and freshly calcined lime, and then submitting it to re-distillation."

142. For an *Improvement in the Manufacture of Zinc White;* Smith Gardner, City of New York, Assignor (through others) to Edward Kellogg, Brooklyn, New York.

Claim.—"The combination of the fire chamber, the vaporizing chamber or oven, and the oxydizing chamber."

ADDITIONAL IMPROVEMENT.

1. For an *Improved Lubricator;* Robert M. Wade, Wadesville, Va.: original patent dated June 6th, 1854; additional improvement dated March 27th, 1855.

Claim.—"1st, The division of the plug into the longitudinal chambers, and the relative positions of the feed and discharge openings in said chambers, so that while one chamber is discharging, a simultaneous feed will take place in the other. 2d, Disclaiming the tubes as mere vent passages, I claim their insertion relative to the feed openings of cup and plug, whereby they perform the double function of vent and steam passages; the feed openings of the plug passing under the tubes and discharging the steam contained in the plug, clear of the oil in the cup, before communicating with the feed channel of the cup."

Re-Issues for March, 1855.

1. For an *Improvement in Grain and Grass Harvesters;* John H. Manny, Rockford, Illinois; original patent dated October 17th, 1854; ante-dated June 15th, 1854; re-issue dated March 6th, 1855.

Claim.—"Making the outside or dividing finger hollow, so that while it affords sufficient room for the play of the end of the sickle, the bearing of the latter therein will not be so long as to afford a lodgment of the grain, grass, &c., in sufficient quantity to clog it."

2. For an *Improvement in Grain and Grass Harvesters;* John H. Manny, Rockford, Illinois; original patent dated October 17th, 1854; ante-dated June 15th, 1854; re-issue dated March 6th, 1855.

Claim.—"The combination of the reel for gathering the grain to the cutting apparatus, and depositing it on the platform, with the stand or position for the forker arranged and located to enable the forker to fork the grain from the platform, and deliver and lay it on the ground at the rear of the machine."

3. For an *Improvement in Grain and Grass Harvesters;* John H. Manny, Rockford, Illinois; original patent dated October 17th, 1854; ante-dated June 15th, 1854; re-issue dated March 6th, 1855.

Claim.—"The combination of the fence to compress the grain against, at the outer end of the machine, and guide it while sliding off the platform, and the position stand or seat for the forker at the inner end of the platform with the platform."

4. For a *Design for Metallic Coffins;* Martin H. Crane, Assignor to Crane, Breed & Co., Cincinnati, Ohio; dated Jan. 23, 1855; re-issue dated March 13, 1855.

Claim.—"The ornamental polygonal design for a metallic burial case or coffin."

5. For an *Improvement in Machinery for Separating Flour from Bran;* Issachar Frost, and Jas. Monroe, Albion, Michigan; original patent dated February 27th, 1849; re-issue dated March 13, 1855.

Claim.—"1st, The platform, (always at right angles with the sides of the bolt when not made conical,) or close horizontal bottom, when used in connexion with upright stationary or revolving bolt for flouring purposes. 2d, The opening for the admission of a counter current of air through the bottom and into the bolt, and the opening and bran spout, in combination with the platform. 3d, The upright stationary bolt, or bolt and scourer combined, with its closed-up top, except for air and material, or in combination with claims first, second, and fourth, or either of them, or their equivalents, to produce like results in the flouring process. 4th, The use of the revolving, distributing, scouring, nd blowing cylinder of beaters and fans, by which the material is distributed, scoured, and the flour blown through the meshes of the bolting cloth."

Designs for March, 1855.

1. For *Table Forks;* J. W. Gardner, Shelburne Falls, Mass.; dated March 20, 1855.

Claim.—"The peculiar configuration of the parts."

2. For *Cooking Stoves;* Jacob Beesley and Edward J. Delany, Philadelphia, Penna.; dated March 20, 1855.

Claim.—"The design for Fanny Forrester Stoves."

APRIL 3.

1. For an *Improvement in Factitious Oils;* Henry W. Adams, City of New York.

Claim.—"The use of crude turpentine in a mixture made with it and the fixed oils."

2. For an *Improvement in Presses;* James P. Arnold, Louisville Kentucky.

Claim.—"Operating the shipper that moves the belt along the cones, by the descent of the platen whilst pressing, so that the power shall be increased with the resistance, until the material is pressed, and then allowing the shipper to run back at an increased velocity when the bale is ready to be removed."

3. For an *Improvement in the Manufacture of White Lead by Precipitation;* Richard Baker, Newark, New Jersey.

Claim.—"An improvement in the combination of apparatus, so arranged as to produce carbonate of lead by precipitation, more expeditiously and economically than by any other arrangement heretofore used for the same purpose. Connecting with an air pump a series of vertical distribution pipes, consisting of a great many in number, descending vertically from the main horizontal pipe, and passing down through the head of the precipitating vessel into the solution of sub-acetate of lead, one pipe at least through each square foot of surface of the top of the precipitating vessel, thereby traversing the solution with a great number of small jets or blasts of carbonic acid gas, causing a very rapid decomposition of the solution; as the vertical pipes cannot choke up with the ponderous precipitate, a constant blast from each pipe is thereby insured."

4. For a *Method of Lubricating Pistons of Air Pumps;* Abel Barker, Honesdale, Pa.

Claim.—"The transference of the lubricating oil from the bottom of the engine cylinder to the upper side of the piston thereof, for the purpose of insuring the proper lubrication of said piston."

5. For an *Improvement in Seed Planters;* Chester B. Borden, Benjamin S. Borden, and Aaron R. McLean, West Dresden, New York.

Claim.—"Attaching to the handle of an ordinary hoe, a chamber or box which contains the corn or seed to be planted, said chamber or box being provided with a slide, D, having a slot or recess in its lower end, which slot or recess may be increased or diminished in size by adjusting the small slide, E. The slide, D, being arranged so as to be operated by the fingers of the operator, and the spiral spring, for the purpose of depositing the seed or corn in the holes or furrows in the earth made by the hoe."

6. For *Improvements in Condensers for Steam Engines;* Louis Bollman, City of N. Y.

Claim.—"1st, The method of controlling the injection of cold water into the condenser by connecting the injection cock or valve with a piston, or its equivalent, which is exposed on one side to the presence of the atmosphere, and on the other to the pressure within the condenser, and is acted upon by variations in the pressure in the condenser so as to increase or diminish the injection as the said pressure diminishes or increases, and to stop the injection when the desired vacuum is obtained. 2d, The employment, for the purpose of heating a sufficient quantity of water to supply the boiler to a higher temperature than the water delivered by the air pump, of an additional injection pipe to inject the said quantity of water at the commencement of eduction into the eduction pipe or passage, the cylinder, or any convenient place near the entrance to the condenser, combined with a receiver, which is arranged and furnished with any suitable means of opening it at the commencement of eduction and injection to receive the said water, and of shutting it off from the condenser before the temperature of the latter is too much reduced."

7. For an *Improvement in Ships' Riding Bitts;* Thos. Brown, London, England.

Claim.—"The tubular metallic riding bitts, when entirely secured to a single deck of a vessel."

8. For *Adjustable Paddle Wheels;* Levi M. Dehart, Reading, Pennsylvania.

Claim.—"In combination with the hollow arms permanently fixed to the hub, the arms carrying the sections of the buckets, when said arms are so arranged as to be slid within the hollow arms by a rack and pinion, or its equivalent."

9. For an *Improvement in Anchors;* Richard V. Guinow, Brooklyn, New York.

Claim.—"The method of fitting a pair of movable flukes to a suitable anchor, so as to fit it to hold in soft or sandy soil, by means of the tie-rods, thimble, and collar."

10. For an *Improved Safety Port for Coal Holes;* Samuel W. Frost, Boston, Mass.

Claim.—"Combining with the door and the frame, or the vault opening, a safety guard applied thereto."

11. For *Improvements in Valves for Steam Engines;* Thomas Goodrum, Providence, Rhode Island.

Claim.—"1st, The rotary tubular valve, having openings and cavities, arranged to communicate with the induction, and with one, two, or more openings or ports leading

to one end, and a corresponding number of ports leading to the opposite end of one, two, or more cylinders, whereby the same valve is enabled to control the induction and eduction of steam to both ends of one, two, or more cylinders. 2d, The variable cut-off, consisting of two segments of cylinders, and plates applied within the tubular valve. 3d, Arranging the valve casing and the tubular valve with the axis of the valve, in line with the cylinder or cylinders, so as to bring the valve into an equally convenient position, relatively to two or more cylinders, and enable the length of the passages from it to the cylinders to be reduced to the greatest possible degree."

12. For *Direct Acting Hydraulic Steam Pumps;* Robert B. Gorsuch, City of N. York.

Claim.—"Effecting a water pressure upon the suction end of the pump plunger, in direct acting steam pumps, at or near the completion of the stroke, without diminishing the resistance against the forcing end of the plunger, for the purpose of closing the suction valves, filling the vacuous space in the pump chamber, preparing the force valves for opening and acting conjointly with the steam pressure upon the piston, whereby the steam valve is operated with precision, whatever may be its velocity."

13. For an *Improved Hose Coupling;* Smith Groom, Troy, New York.

Claim.—"A hose coupling composed of two parts, on one of which are spring clamps or jaws controlled by a friction ring, and on the other a groove into which said jaws or clamps take, the whole being so arranged when united as to make a tight joint, and yet allow one half of the coupling to turn on the other half without uncoupling it."

14. For an *Improvement in Ploughs;* Thos. J. Hall, Tawakana Hills, Texas.

Claim.—"The so hanging of the cutter to the beam as that it may swivel therein, in combination with the supports at the edge of the wheel."

15. For an *Improved Valve for Wind Musical Instruments;* G. Hammer, Cincinnati, O.

Claim.—"The combination of the bow, string, and the screw, for working themselves and preventing the string from slipping. Also, the privilege of applying the improved valve to all musical instruments to which such valves are commonly attached."

16. For an *Improved Mode of Loading Rifled Cannon;* L. Houghton, Philada., Pa.

Claim.—"For loading rifled or grooved cannon, the employment of a deep sabot at the base of the projectile, so as to be driven thereon, and into the grooves of the gun at the moment of discharge, for rendering said grooves effective in producing the rotation of the projectile."

17. For an *Improvement in Looms;* Barton H. Jenks, Bridesburgh, Pennsylvania; ante-dated January 8th, 1855.

Claim.—"The yielding rest or support for the picker, to break the sudden blow or concussion with which the shuttle impinges upon the picker, thereby preventing the filling of the cop from being jarred off and entangled, and relieving the picker from danger of being broken. Also, separating or freeing the picker from the end of the shuttle by the same movement which shifts the shuttle boxes, operating through a combination of levers, cams, and springs, or through levers, cams, or treadles, worked from any part of the loom."

18. For a *Double Acting Pump;* Benjamin F. Joslyn, Worcester, Massachusetts.

Claim.—"Forming a direct passage to admit fluids to one part of the cylinder, by means of a tube attached to and working with the piston, and passing through the other part and end, when applied to double acting pumps, or any other."

19. For an *Improvement in Rakes and Hay Elevators;* William J. Keeney and James R. Tarbox, Switzerland County, Indiana.

Claim.—"The combination of the apron, endless belt, and elastic clearers, either alone or in connexion with two driving wheels, clutches, and a rake, placed behind, for the purpose of raking and elevating hay."

20. For an *Improved Apparatus for Hoisting and Dumping Coal Cars;* Geo. Martz, Pottsville, Pennsylvania.

Claim.—"The combination of the coal car and its carriage with the hoisting carriage, in such a manner that whilst the hoisting carriage is guided vertically up the shaft by its ways, the carriage of the coal car is guided by the independent ways in such a man-

ner as to tilt the car when it obtains the proper elevation, and place it in such a position that its contents will be self-discharged into the shute."

21. For an *Apparatus for Feeding Paper to Hand Printing Presses;* Ebenezer Mathers and William D. Siegfried, Morgantown, Virginia.

Claim.—"The feeding hand presses, automatically, by means of the operation of the clamps, guide rods, cords, weights, pulleys, catches, and springs."

22. For an *Improvement in Cotton Gins;* James B. Mell, Riceborough, Georgia.

Claim.—"The combination of the beater, card cylinder, brushes, and plate."

23. For an *Improvement in Lancets;* Henry Mellish, Walpole, New Hampshire.

Claim.—"The construction of a lancet, in combination with a charger and piston inside its blade, for the purpose of depositing vaccine, or other matter, in a puncture made for that purpose, before the lancet is drawn."

24. For an *Improvement in Coal Hole Covers;* F. H. Moore, Boston, Massachusetts.

Claim.—"The method of securing the coal hole cover by means of the rods, or their equivalents, whereby the cover may be raised more or less, as required, for purposes of ventilation, or for the introduction of coal, and all dangers to passers by is avoided."

25. For an *Improvement in Breech Loading Fire Arms;* R. White, Hartford, Conn.

Claim.—"1st, The application of the sliding breech to operate in connexion with the trigger through a tumbler, in substantially the same manner as the hammer in ordinary fire arms, thereby making the breech serve not only its proper purpose of closing the rear of the chamber, but as the hammer for effecting the explosion of the charge. 2d, The spring plate, applied to serve as a guide to conduct the cartridge into the open chamber, and as a guard to prevent the cartridge falling out at the rear of the chamber, before the breech is liberated."

26. For an *Improved Stove Pipe Tube;* Thomas Moore, Fair Haven, Vermont.

Claim.—"The double and adjustable concentric tubes, or stove pipe thimbles."

27. For an *Improvement in Pulley Arrangements for Dumb Waiters;* Andrew Murtaugh, City of New York.

Claim.—"The manner of arranging and suspending the waiter and weight between the cords, arranged double over pulleys."

28. For an *Improvement in Seed Planters;* Ives W. McGaffey, Syracuse, New York.

Claim.—"The combination of the fertilizer tilt apron with the seed distributing roller."

29. For a *Fire Proof Floor and Ceiling;* F. A. Peterson, City of New York.

Claim.—"The method of making fire proof floors and ceilings, by means of metallic flanched beams, in combination with tile tubes interposed between and resting on the flanches of the beams, and filled in above."

30. For a *Fire Escape Ladder;* Stephen R. Roscoe, Carlisle, New York.

Claim.—"The combination and arrangement of the mortise, tenon, spring latch, hook, and the groove in which it traverses. In combination with the above described sectional ladder, I claim the traversing platform and traversing roller, so constructed and arranged as to allow the sections of the ladder to be operated for fire escapes and other purposes."

31. For an *Improvement in Railroad Car Seats;* Alpheus D. Smith, Meredith, N. Y.

Claim.—"The combination of the arms which project from the back of a car seat, with the movable bars, which are combined with the car seat, and its arms, or their equivalents, in such a manner that by the aid of the shoulders on the standards, the back of the seat may be supported in the proper position for day riding, or be elevated into the proper position for night riding, and supported in that position."

32. For *Chain Pumps;* Arcalous Wyckoff, Columbus, Ohio.

Claim.—"The application of an elastic or other suitable valve, to an endless chain pump cylinder, said valve being arranged so as to be capable of only opening upward."

33. For an *Improved Protector for Lamp Shades;* Chas. Wilhelm and Anna C. Wilhelm, Philadelphia, Pennsylvania.

Claim.—"The introduction of mica as a transparent non-conducting material between the shade and the frame, for the purpose of preventing the shade from taking fire, or being otherwise injured, whilst the light is as free to be reflected as though there was nothing interposed between them."

34. For an *Improvement in Bank Locks;* C. Gustav Mueller, Charleston, S. C.

Claim.—"1st, A key provided with extension bits, the individual length of each of which can be altered at pleasure, and still be applicable to the lock. Also, the arrangement of the plates and slides for preventing any friction, and so as to prevent the possibility of feeling how the plates or slides are connected. Also, the bars, having saw toothed racks, as arranged with the sliding bars, and the projecting pins for operating them from the outside of the lock. Also, the arrangement of the horizontal changeable sliding pins which are moved by the bars, the rack toothed wheels or segments, and forked lever, which is moved by the projection on the circular plate. Also, as arranged, the bars and the stationary plate for holding the pins when they are withdrawn from said bars. Also, the arrangement of the knob, the collar with its bent arm, and the circular plate for turning and holding said plate. Also, as arranged, the rod of the inner knob, the lever 2, shaft, lever *a*, plate, and its spring for connecting said knob with the bars and operating them."

35. For an *Improvement in Repeating Fire Arms;* Rollin White, Hartford, Conn.

Claim.—"Extending the chambers of the rotating cylinder right through the rear of the said cylinder, for the purpose of enabling the said chambers to be charged at the rear, either by hand or by a self-acting charger. 2d, The application of a guard to cover the front of all the chambers of the cylinder, which are not in line with the barrel, or any number thereof which may have been loaded, combined with the provision of a proper space for the lateral escape of the exploded powder, whether the said space be between the cylinder and guard, or in rear of the cylinder, and whether the said guard be constructed with a recess to receive the balls, or be of such form as merely to stop the balls. 3d, Combining a charging piston with the hammer by means of gearing, or by the equivalent thereof, in such a manner that by raising the hammer to cock the lock, the piston is moved towards the chambered cylinder, to force a cartridge from the magazine into one of the chambers thereof, and by the falling of the hammer the piston is withdrawn to allow a new cartridge to be supplied, ready to be driven into the next chamber of the cylinder as the hammer is again raised to cock the piece. 4th, Furnishing the hammer with an attachment, by which, in the act of falling, it may close the mouth of the magazine before exploding the priming, and thus protect the charges within the magazine from ignition."

36. For an *Improved Repeating Fire Arm;* Rollin White, Hartford, Connecticut.

Claim.—"1st, The method of combining and applying the magazine and charging tube, either for cartridges or priming, to wit: the charging tube being arranged in line with the chamber or one of the chambers, or the nipple or one of the nipples of the piece, and the magazine being arranged in such a manner relatively thereto, that the cartridges or caps lie side by side to be sideways, one by one as required, into the charging tube by gravitation, a spring, or other means, on the retraction of the said piston from opposite the magazine, and to be fed into the chamber or on to the nipple by the movement of the piston towards it. 2d, Combining the rotating chambered cylinder with the charging piston, or its equivalent, so that by the operation of retracting the charger after charging a chamber of the cylinder, the cylinder shall be rotated to the extent required to bring a new chamber in line with the barrel. 3d, Combining the hammer with the charging piston, so that the operation of moving the charging piston to drive a cartridge from the magazine into the chamber, the hammer shall be raised to cock the lock. 4th, The spring protecting plate, applied to fall into notches in the rear of the rotating cylinder, to protect the other charged chambers from the effects of lateral fire from the discharge of the chamber which is in line with the barrel."

37. For an *Improvement in Ploughs;* Noah Warlick, La Fayette, Alabama.

Claim.—"The whale lance-shaped point, having a notch in its upper side to receive the lower end of the coulter, in combination with said coulter and the Y-shaped adjustable double brace."

38. For an *Improved Excavating Machine;* C. Williams, Jackson, Tennessee.

Claim.—"Having the frame or shaft of the scoop or shovel formed of two bars, and having said bars working between friction rollers in guide plates at opposite sides of the pole."

39. For *Mechanism by which Approaching Vehicles Open and Close Gates;* Enos Woodruff, Elizabethtown, New Jersey.

Claim.—"1st, Applying weights, in manner specified, or any similar manner, to the operating the gate. 2d, The application to gates of mechanism for causing both latches to lift at the same time. 3d, The application of catches with one side higher than the other, to a rotating gate. 4th, The manner of preventing the tread of an animal from opening the gate, or any mode analogous thereto."

40. For an *Improvement in Cultivators;* Francis L. Smithson, Mecklenburgh Co., Va.

Claim.—"The combination of the harrow teeth and cylinder in tobacco cultivators."

41. For an *Improved Arrangement of Means for Freeing Steam Boilers from Sediment;* Hiram Strait, Covington, Kentucky.

Claim.—"The arrangement and combination of the valved partition, blow-off pipes, and cock or valves, so as to expel its sediment, mud, scales, impurities, or incrustations, at any time and in a few minutes, by the joint or separate force and pressure of its own steam and water, without exhausting either or suspending any of its ordinary duties or business, and thus render a steam boiler strictly and thoroughly self-cleaning."

42. For an *Improved Breech Loading Fire Arm;* G. H. Soule, Jersey City, N. J.

Claim.—"The use of the double acting cam, in combination with the charging chamber and breech piece, having an opening in it for cutting off the end of the cartridge, and discharging the fragments thereof from the charging chamber, the said parts made and operating in combination with the barrel and magazine of a gun."

43. For an *Improvement in Folding Bedsteads;* Wm. Stoddard, Hingham, Mass.

Claim.—"Making the side rails of bedsteads in sections, hinged together, and also to the head and foot posts, so that they will fold together, in combination with the slats which support the bedding, which slats are so constructed and provided with pins or projections near the ends of them as to brace or hold the folding rails firm when the bedstead is extended."

44. For an *Improved Grain Cleaner;* Benj. T. Trimmer, Parma, New York.

Claim.—"The construction and arrangement of the india rubber scroll and spring teeth, regulated by the bridge-tree."

45. For an *Improvement in Washing Machines;* G. W. Edgcomb, Lima, Indiana.

Claim.—"The alternating radial arrangement of the tapering rubbers upon the under side of the actuating disk, and upon the bottom of the tub."

46. For an *Improvement in Harrows;* Charles Clareni, Assignor to self and George P. Field, City of New York.

Claim.—"Making the rotating harrow in flexible segments."

47. For an *Improvement in Scrapers for Removing Dirt from Boots and Shoes;* Ozro A. Crane and Henry J. Lewis, Assignors to Ozro A. Crane, Green Point, N. Y.

Claim.—"The method of causing the brushes to accommodate themselves to any size or shape of boot or shoe, and brush off both sides at once, by so attaching said brushes that they shall be forced together by springs."

48. For an *Improvement in Fixtures for Curtain Rollers;* J. Hartshorne and Dexter H. Chamberlain, Assignors to John Hartshorne, Boston, Massachusetts.

Claim.—"The bent socket pivoting upon the window jamb, and secured thereto by means of screws, whereby sufficient friction may be placed upon the rod to balance a curtain of any size or weight, without the use of springs or other contrivances for the purpose."

MECHANICS, PHYSICS, AND CHEMISTRY.

On the Manufacture and Application of various Products obtained from Coal (Coal-gas excepted.) By Prof. F. Crace Calvert, F. C. S., &c.*

(Continued from page 285.)

Discussion.—The Chairman said it now became his duty to invite discussion on the very interesting paper just read, and he was sure all must be pleased with the animation and vigor with which the subject had been brought before them. Mr. Crace Calvert was a bright example of the importance of that happy alliance between England and France which they were all anxious to encourage. Mr. Calvert studied chemistry under the first French chemists, Chevreul and Dumas, and so long did he remain abroad, and so assiduously did he devote himself to his studies, that when he returned to England he had lost his native tongue. He was glad however now to find that he had regained the proper use of his own language, and that he still retained all the animation of our neighbors. The subject which Mr. Crace Calvert had brought before them was not only of great practical importance, but of great philosophical interest. When lecturing in this room on the Results of the Exhibition of 1851, he (Dr. Playfair) declared that the great end in modern civilization was to effect an economy of time, or to make the most refuse products conducive to the advantage of manufactures and arts. When coal gas was first introduced into use, it was contended that there was an intolerable quantity of refuse for which no use could be found, but now there was not one particle of that refuse, with the exception of the naphthaline, which was not already of great commercial importance. So important indeed had the waste products become, that many of their manufactures could not get on without the oils and dyes produced from them. Mr. Crace Calvert in alluding to the various products from coal, with the exception of the gases, had divided them into aqueous and tarry, and if he (Dr. Playfair) alluded to them, it was only to call their attention to some points which Mr. Crace Calvert had not noticed. That gentleman had shown them how alum was obtained, and had spoken of it with a fondness as though it were a child of his own, and he had pointed out its importance in dyeing; but whilst dilating on the importance of ammonia in its general applications, he did not tell them that it was from that fetid mass that ladies' smelling bottles were filled, and that they derived sal volatile. Then, again, benzine had a most extraordinary effect in cleaning white kid gloves, as he could testify, and that, too, without leaving that roughness which generally attended the operation. Then with regard to carbolic acid, it was expected to prove a most valuable antiseptic, though it had hitherto not been much employed, excepting in the preservation of wood. Mr. Crace Calvert, in speaking of several of these discoveries, had referred to a certain gentleman in Manchester, but he had too much modesty to tell them that that gentleman was Mr. Crace Calvert himself; and with reference to carboazotic

*From the Journal of the Society of Arts, November, 1854.

acid, should it prove as valuable a febrifuge as he anticipated, it would stamp Mr. Crace Calvert as one of the greatest benefactors of mankind. He had next referred to naphthaline, the odor of which chemists had not yet been able to get rid of—though it would yet be got rid of, and the substance rendered useful in dyeing. He had also shown them how the refuse of coal might be made useful in the manufacture of solid paraffine and paraffine oil. Paraffine obtained from other sources had been long known as a most useful lubricator, and was originally proposed for the works of chronometers. Paraffine had this advantage—it would not combine with the oxygen of the air, and thus become rancid. Paraffine oil from coal possessed all the advantages of solid paraffine, and was now used almost all over the country for lubricating machinery. The reason why the beautiful paraffine candles they had been shown that evening were not brought extensively into use, was, that the manufacturers of the article had a demand for it in its liquid state beyond what they could meet, and therefore it was not to their advantage to manufacture it into candles. He had only thus run through the principal heads in order to point out the subjects for discussion, and should now be happy to hear any gentleman upon it.

Mr. Winsor trusted that he might be allowed to express the deep debt of gratitude which they must all owe to Mr. Crace Calvert for the pleasure, entertainment, and information they had derived from his paper that evening. He had had the honor of being a member of the Society of Arts for upwards of thirty years, and being the son of the introducer of gas lamps into England, if not throughout the whole world, he trusted he might be excused for presuming to address them. He certainly had felt somewhat astonished at what he had heard that night. He recollected when Dr. Playfair was lecturing on the Great Exhibition, in alluding to his father, he spoke of the indomitable perseverance of Mr. Winsor, and he now begged to thank him for that testimony to his father's memory. He now wished to call their attention to the evidence given before Parliament in 1809, when the Chartered Gas Company was applying for its Act of Incorporation. In the preamble of their bill it was set forth that the products of coal were gas, pitch, tar, essential oils, and ammoniacal liquor, and they then produced in the House of Commons specimens of those products of which since so much had been made. He now had great pleasure in moving a vote of thanks to Mr. Calvert for the mass of information which he had laid before them, and for having shown them how the various products of coal would benefit the whole country, —as gas had for several years. He should be happy at any time to render any information to the Society on the gradual progress of gas manufacture, and he hoped ere long to embody in a work which he would lay before the public, the history of gas-lighting for half a century, leaving it to the scientific world to determine upon its value.

Mr. Varley seconded the motion, and expressed the great satisfaction with which he had heard the observations relative to extending a knowledge of science amongst the people.

The Chairman said, that before putting the question, he would ask if any gentleman wished to make any observation, and he particularly alluded to Mr. Bethell as having had his invention noticed.

Mr. Bethell said, that it was most difficult to touch the various questions brought before them that evening without occupying several hours of their time. Mr. Crace Calvert had brought the subject before them in a very lucid and talented manner, though he had been obliged to notice very cursorily many points for want of time. The possibility of the preservation of wood by tar oil had struck him whilst seeking for some material to preserve wood for railway sleepers. The stone sleepers originally laid down were found to destroy the carriages very quickly—and it being desirable to use some softer material, wood naturally presented itself. How to preserve it then became a question, and it was proposed to use solutions of various chemical salts. It was considered that the decay of wood was principally caused by the albuminous nature of the sap, and that if some matter could be obtained to coagulate it, the decay would be stopped. Corrosive sublimate, and sulphate of copper, were therefore tried for this purpose. It was found, however, in practice, that this process was too expensive, and besides, although it prevented the putrefaction of the sap, it had no effect on the fibrous matter of the wood. He then determined to try the oil of tar, and he was induced to do so from finding that the agents used to preserve the Egyptian mummy were of an asphaltic nature—asphaltic oils being collected in great quantities on the Persian Sea, and in different parts of Egypt, where, in consequence of the heat, it exuded through sandy rocks, &c. Finding that this substance was used for making mummies, he considered that what would preserve animal flesh would preserve wood. He, therefore, determined upon using oil of tar, and then came to be considered the mechanical method of making the wood absorb it. He found that where wood had been used perfectly dry it stood uninjured, if protected from the weather, for ages, as was to be seen in the roof of Westminster Abbey; and he determined so to saturate the wood with oil of tar as to render it impervious to water. The result had far exceeded his expectations. A few days ago some sleepers were taken up between Manchester and Crewe, which had been laid down in 1838, in order that they might be replaced by some of a heavier description, when it was found that the old sleepers were perfectly sound, and they were about to be used on parts of the line where there was less traffic. The unprepared sleepers never lasted more than four or five years. A great many improvements in this country were stopped by the prejudice which people had against anything bearing the smell of gas. For instance, pitch and other products of tar were highly-important in ship-building, yet, so prejudiced were the English ship-wrights against coal-tar and pitch, that they would only use the tar and pitch from Archangel or Stockholm, though it cost ten times as much as the English. In the Mediterranean the native vessels which were not coppered suffered very severely from the worm, and the Maltese and Sicilians found that the Archangel and Stockholm pitch would not protect them, but with the coal pitch and tar no worm would touch the vessels, and there was, therefore, a great demand for the English pitch and tar in the Mediterranean, the boat-builders of which would readily give more for it than for the vegetable pitch or tar; but there was a prejudice against it in England because it was to be obtained cheaply at our very doors. In fact, all pitch and tar from the mineral kingdom was much

better and stronger than that from the vegetable, and much more of a preservative. By the injection of the carbolic acid from tar, mixed with a little olive oil, into the veins of the body, they might keep anatomical subjects fresh for many weeks, and it would have no effect upon the scalpel, which showed the great power and usefulness of the carbolic acid; and the only reason why it had not been extensively used for the preservation of meat was that the gaseous smell would be more or less retained.

In answer to a question from Mr. Winkworth, Mr. Crace Calvert stated that there could be no doubt that when they wished to disturb the streets, paved as Manchester was, for the gas or water pipes, that as the stones had to be raised by the pick-axe there was considerable labor required beyond that for removing the ordinary pavement. The reason why it was not more generally used he could only suppose was that each locality had its own peculiar manner of doing things; but any one who rode over the streets of Manchester could not fail noting how free they were from the jolting and reverberation felt in London and other cities.

The Chairman, in putting the motion, said he could not help remarking how deeply he sympathized with the remarks of Mr. Crace Calvert relative to the popularizing of science; and he might take that opportunity of informing them that so desirous were the Government to aid in that object that they had prevailed on Dr. Hofmann, one of the most eminent chemists of the day, to deliver a course of lectures on chemistry at the School of Mines, for the almost nominal charge of 5s. the course—instead of about £5—and sure he was that it was as little as it could be done for to remunerate the professor at all.

Mr. Crace Calvert returned thanks, and expressed the gratification he felt at what he had just heard from Dr. Playfair, trusting that the same advantages would shortly be extended to Manchester, Birmingham, and other places. Sure he was, if Dr. Playfair had but a few coadjutors as enthusiastic in extending a knowledge of science as himself, it would soon become as popularized as the most earnest lover of science could desire.

On the Flow of Water through Pipes and Orifices. By Mr. J. Leslie, M. Inst. C. E.*

The author having been professionally called upon to report on a small scheme of water supply, in which it was proposed to lay down a pipe with an unusually small declivity, was induced to have a set of experiments made on the discharge of a new lead pipe of 2½ inches diameter and 1086 feet in length, with heads varying from $\frac{3}{16}$ths of an inch to 10 feet. This pipe was laid in a coil of about 70 feet in diameter, and was afterwards successively shortened into lengths of 540 feet, 270 feet, 100 feet, 25 feet, and 10 feet. Other experiments were also made with pipes of 1¼ inch and 1¾ inch diameter.

As much care as possible was taken to insure the escape of air; but

* From the Lond. Artizan, March 1, 1855.

the results were in some cases so anomalous as to induce the belief that complete success had not, in this respect, been always obtained.

The pipes were also carefully joined and soldered, and it was believed that, with one trivial exception, no internal obstruction had existed.

The observations, which were exceedingly numerous, were stated to have been made with much care by Mr. John Lamond, an assistant of the author; and these had been tabulated at great length, and were annexed to the paper.

The object of the author having been to institute a comparison between the deductions of hydraulicians and the results of direct experiment, he had adopted, as a standard of comparison, a formula which he believed to be due to Du Buat, and from that had calculated "the ratio of actual discharge to Du Buat's formula."

The formula employed was thus expressed :—

$$v = \frac{3000\sqrt{d}}{\sqrt{\frac{l}{h}}}$$

in which v was the velocity per minute, l the length of the pipe, increased by 50 diameters, and d the diameter of the pipe, all in feet.

For the discharge (D,) in cubic feet per minute, this formula became

$$D = \frac{2356 \cdot 2\, d^{\frac{5}{2}}}{\sqrt{\frac{l}{h}}}$$

Adopting this formula, the following were a few of the results obtained from the pipe $2\frac{1}{2}$ inches diameter :—

Pipe $2\frac{1}{2}$ inches diameter, 1086 long + 50 diameters = 1096 feet.

Head.		Gradient.	Observed discharge, cubic feet per minute.	Ratio of actual discharge to Du Buat's formula.
Ft.	In.			
0	0 3-16	1 in 70,256	·0444	·252
0	1	" 13,152	·2048	·503
0	$1\frac{3}{4}$	" 7,515	·241	·448
0	$2\frac{1}{2}$	" 5,260	·4412	·684
0	$5\frac{1}{2}$	" 2,391	·7407	·776
1	$5\frac{3}{8}$	" 757	1·4634	·863
2	$9\frac{3}{8}$	" 394	2·22	·945
4	$9\frac{1}{2}$	" 230	3·	·975
7	$0\frac{1}{8}$	" 156	3·53	·945
9	$11\frac{7}{8}$	" 109	4·286	·961

(It was shown in the discussion, which was only commenced, that the formula relied upon by the author was not that of Du Buat, which when applied gave results more closely approximating to those of the experiments than were obtained by the formula employed in the construction of this table.)

Numerous experiments were also made on simple orifices—on short tubes placed sometimes vertically, and sometimes horizontally—and on vertical pipes, from which coefficients of discharge, greatly at variance with accepted data, had been deduced; but it was afterwards discovered that the apparent anomaly disappeared if the active head were measured by the difference of level between the surface of the water in the cistern and the point of exit from the pipe, or the difference of level of the water in the upper and the lower cisterns.

Observations on a large scale were also made on the pipes of the Edinburgh Water Company. The "Crawley pipe" was 15 inches in diameter and 44,400 feet long, with a differential head of 226 feet. The actual discharge was 255 cubic feet per minute; whereas, by the formula, it ought to have been 294 cubic feet per minute. This pipe was, however, thirty years old, and was known to be considerably reduced in diameter by incrustation.

The "Colinton pipe" was 16 inches diameter, 29,580 feet long, with a differential head of 420 feet. The mean of fifteen observations gave an actual discharge of 571 cubic feet per minute; whereas the formula required that the discharge should have been 575 cubic feet per minute. This pipe was only eight or nine years old.

A section of the same pipe, of 25,765 feet in length, with a differential head of 230 feet, yielded, on a mean of twenty-six observations, 440 cubic feet per minute; whereas the discharge by the formula should have been 457 cubic feet per minute.

Another section of the same pipe, 3815 feet in length, with a differential head of 184 feet, yielded 1215 feet per minute, instead of 1063 expected from the formula; but a new iron pipe of $2\frac{1}{2}$ inches diameter and 1150 feet long, with about 11 feet of fall, yielded about what was due by formula to a pipe of $2\frac{1}{4}$ inches diameter.

Observations were also made on the Dundee conduit, which was 2 feet broad, with rectangular sides and a bottom of smooth stone slabs, with the following results:

Fall 1 in 1000.

Depth.	Calculated discharge.	Actual discharge.	Actual average ascertained velocity.	Velocity by floats at surface.
Inches.	Cubic feet.	Cubic feet.	Cubic feet.	Cubic feet.
6	109·	110·09	110·09	128·5
7	134·	134·83	116·	129·7
8	160·	162·16	121·6	133·1
9	186·	184·61	123·	136·7
10	213·	214·28	128·6	138·1
11	240·3	240·	131·	140·
12	268·	266·6	133·3	146·7

The formula used in this instance might be thus expressed:—

$$\tfrac{1}{10}\sqrt{\text{hyd. mean depth} + \text{fall in feet per mile}} = \text{velocity in miles per hour.}$$

The discharges by the sluices of the dock-gates of Dundee and the lock-gates of the Monkland Canal were also ascertained and tabulated. (The mean of the first seven observations gave a coefficient for feet of 5·3, and of the next four observations, omitting one imperfect observation, of 5·25, which were consistent with the received formula.)

A few experiments were also undertaken with respect to the flow of water over notch-boards; and some investigations were made for the purpose of determining whether the theoretical addition of 50 diameters to the length of the pipe was practically correct.

The author's conclusions were, that while "Du Buat's" formula gave very accurate results at moderate rates of inclination, it gave a great deal more than the actual discharge with very low gradients, and very considerably less with steep gradients.

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*On Steam Boiler Explosions and the Explosive Force of Highly Heated Water.** By JOHN SEWEL, Assoc. Inst. C. E., Great Western Railway, London.†

The frequent occurrence of disastrous boiler explosions has largely attracted scientific, practical, and popular attention, and to endeavor to guide this attention to some practical benefit is the object of this paper. The investigations which take place after explosions, chiefly turn on the magnitude of the force which produced the visible destruction. That destruction it is conceived may be readily traced to the elastic force of the body of water and steam when suddenly expanding, without ascribing it to greatly increased pressure per square inch before explosion takes place. If this can be shown satisfactorily, it will lead to more attention to evidence often discredited, because it appears at variance with the effect of the explosion, and the assumed strength of the boiler. In each instance of explosion there are two opposing forces to be estimated—first, the strength of the boiler; and second, the strength of the steam. The first possesses a nearly non-elastic power of passive resistance, but the second an expansive power of vast extent, which concentrates its entire force with terrible effect on the smallest yielding of its passive opponent. Such are the antagonistic forces, and such is the difference in their relative powers; but a few remarks on each of them will render these differences more appreciable.

First, then, is the question of the real strength of the boiler. Mechanically, this depends upon the design, the materials, and the workmanship: when all three are good, a maximum strength is attained, but when any one part of them is defective, that defect rules the strength of the boiler, as bad gradients rule the tractive power of locomotives. A serious evil attends these local defects, from their becoming more acted on by the expansive and contractive motion of the boiler than the other parts. Thus slowly the cohesion of the iron is injured at these points, until some day it fails to resist a pressure it had again and again, it may be years, resisted with safety. The materials used in constructing boil-

* From the London Mining Journal, November, 1854.

† Read at the British Association Meeting, Liverpool, September, 1854.

ers are chiefly iron and copper, and various experimenters have given reliable data of their cohesive power—of the rapid loss of strength in copper by increase of temperature, of injury to the best iron by long-sustained vibrations, and the serious loss of strength by the ordinary single riveted joints. These researches serve as guides to the designer and constructor of boilers, that the passive resistance at all points may far exceed the elastic power of the steam. The forms of boilers are so often modified by circumstances and by new plans, that no time will be occupied in discussing this part, but it is evident that, whatever the form, the material should be of the very best quality, since the cost of labor may be the same for both good and bad materials, and the difference resolves itself into a few shillings per ton of the materials required. The best materials and the best designs are, however, liable to injury by defective construction, for the mere economy of a little skilled labor.

Some of the chief defects in construction arise from shearing the edges of the plates, punching out the rivet holes, and drifting ill-matched rivet holes in a line by steel wedges, or "drifts," as they are technically called. These sources of injury can all be avoided by planing the edge of the plates, and boring the rivet holes when the plates are in their final position to each other. Shearing injures the fibre of the iron, and shorn strips exhibit a loss of 8 to 10 per cent. as compared with planed strips of the same iron of equal section. Punching out the rivet holes is another source of disturbance to the fibre of the iron, besides the actual loss of metal cut out, which is only made up about 3 or 4 per cent. in the fastening of the rivet head, and when rivets are over hammered, not made up at all, but, on the contrary, cause leakage. To such an extent is the aggregate of this loss, that a single riveted joint is from 40 to 44 per cent. weaker than the plate clear of the rivets. Thus, the boiler is only about half its nominal strength, even when no injury is done to the plates by drifting the rivet holes together. It is difficult to estimate the injury done by drifting, more especially with inferior iron, since it may be carried to that extent as to cause incipient fracture between the rivet holes, and remain unseen after the rivets are fixed. In all such cases the real strength of the boiler is only a fraction of its nominal strength. The weakening effect of the rivet holes might be remedied with a thickened margin all round, so that the part left would equal the plate in strength.

Some years since the writer called the attention of a leading manufacturer of boiler plates to this description of plates, but some objections were urged as to the difficulty of rolling thick edged plates, but it cannot be an insuperable one in these days of progress. Another source of injury to boilers, and one that is seldom noticed, is the liability of the plates being subjected to chisel cuts, and the joints to caulking tool nicks. Experiments on the strength of iron have, in many instances, accidentally shown the decided loss of strength by abrasions of the surface so slight that they were not detected until the early fracture of the iron showed their injurious effect, and ordinarily little care is taken to avoid such abrasions of the surface in making boilers. With such cuts or nicks at any part of a boiler, where the vibrations of contraction and expansion are arrested by any sudden change in the thickness or level of the surface, the fibrous structure of the iron is liable to slow but certain

injury. Analogous to this source of fracture are the numerous well-known instances of railway axles breaking with more or less depth of a crystalline appearance from the surface, but with the central portion fibrous. Much discussion has taken place on this apparent conversion of iron, originally fibrous, into crystalline state, but it appears to the writer that this conversion is strictly local, and confined to a sectional line, where some change of the diameter of the axle-journal arrests the surface wave of vibration produced by the oscillation of the vehicle, so that a broken axle may exhibit a crystalline appearance at the fracture and be quite fibrous on each side of that fracture. Generally the fracture presents a worn appearance more or less deep, next a crystalline aspect, whilst the centre shows the original fibrous structure of the axle. Incipient fracture had commenced at the surface, and attrition afterwards worn it there, whilst the steadily deteriorating vibratory concussions were destroying the fibrous iron in the line of these concussions, until fracture took place under an ordinary load, which had been safely carried many hundreds of times. It is well known to practical men that fractures chiefly occur at the angle of the journal next the wheel, and appear to be due to the waves of vibration being arrested by these angular changes of the surface. The cohesion is ultimately injured there, beginning at the surface, and gradually deepening; therefore the time of fracture will be more or less prolonged, according to the peculiar circumstance of each case. The crystallization is thus believed to be confined to the line of fracture, where contrary currents meet, or are arrested by irregularity of surface; and if this is a correct view of the cause of these axle fractures, it shows that whenever iron has to sustain numerous constant vibrations, whether produced by motion as in railway axles, or by heat and pressure as in boilers, abrupt angles or shoulders should be avoided, so far as it is practicable to do so. If, then, the vibrations to which railway axles are subjected cause their fracture in a few years under the most ordinary circumstances, it may be fairly inferred that boiler plates are as liable to injury, by the vibrations of heat and pressure, as railway axles are to those of motion, and that a boiler plate may equally fracture under ordinary circumstances, often previously withstood. It is of obvious importance that all boilers should be carefully made and tested, and that the consequence of any defect of workmanship may be clearly understood and early discovered. Important as is a good boiler, yet with few exceptions its manufacture is in a very rude state. The engine is carefully fitted up, and where bolt holes are required additional material is given, whilst these holes are carefully drilled, but the reverse of all this takes place with boilers as commonly made. Shearing, punching, drifting, and caulking, show a very primitive mode of making boilers, and the continued use of plain boiler plates, indicates how little has been done to compensate the serious loss of 40 per cent. of the strength by the rivet holes. It is only a question of first cost, for there exists no practical difficulty in constructing a boiler as well proportioned, and as carefully put together, as the engine. And what is this cost compared to the loss caused by explosions? From what has been stated, it is evident that, as ordinarily made, the real strength of a boiler is very much less than its nominal strength, but that by an improved form of plates,

and superior workmanship, the boiler might become a fitting partner to the engine in proportions, in workmanship, and in real strength. Having shown the ordinary sources of inherent weakness in boilers, and that they could be greatly improved; the antagonistic force of steam which they have to confine, comes to be considered under the second division of this subject—or the real strength of steam and water in explosions. It is usual to estimate the force of steam by its distributed pressure in the boiler, and under ordinary conditions this is correct; but an explosion introduces extraordinary conditions, by concentrating on one point the whole of the acting and expansive forces in the boiler. The steam and boiling water, in a boiler working regularly, may be compared to the gentle undulations of the tidal wave on a fine day. Each has its own atmosphere, and each its own body of water in motion. Steam is the boiler atmosphere, amongst which the water rises and falls, by disturbing causes, with equal facility as the tidal wave varies by atmospheric currents or other causes. In locomotive boilers the gauge glass gives the means to observe the full influence of gravity in an atmosphere of steam as high as of 135 lbs. per square inch, or that of nine atmospheres altogether. When this steam is suddenly cut off from the cylinder, and the velocity of the boiler is checked, the water obeys the laws of gravity and motion, by rushing forward to the front end of the boiler, with a corresponding fall at the fire-box or back end, just as a rider at full gallop is thrown forward when his horse is suddenly stopped. In a calm day the stately trees seem to defy any possible atmospheric force, yet even in our own island, the storm frequently prostrates these giants of the forest, and injures the structures of art. Neither is the strength of ships, nor the skill of the mariner, tried on a calm day, but the agitated ocean, too frequently bears witness to the force evoked by atmospheric influence, when directed towards some common centre of disturbed equilibrium. In like manner the boiler appears to exceed in strength the usual or assigned pressure of the steam, but then boilers are liable to defects and deterioration, whilst the steam atmosphere is liable to agitation by suddenly opening or closing the passage to the cylinders or safety valves, and producing steam currents, with their culminating points of increased pressure. Suppose, for example, that a boiler is barely able to confine the steam safely, under the most careful working, the sudden opening of the safety valve, or regulator, would induce a rush of steam to that point, and produce greater pressure directly opposite that opening than on any other part. The pressure from each end of the boiler would compress, as in a slowly closed vice, the water immediately under the opening until the boiler was emptied or burst by the increased pressure of that compressed column of water. Practically, it is also found that a great number of explosions are traceable to such agitation, and the points of fracture to either the points of opening, or immediately opposite that point. Thus a boiler, if supposed only equal to sustain the steam in its ordinary state, the increased local pressure would produce rupture, and an explosion would take place with a force measured by the elastic power of the steam, and the expansive power of the water, into steam at the same instant. The nominal pressure of the steam would bear the same relation to its explosive force, as the ordinary atmospheric

pressure bears to its tempest force, since the explosive force of water is somewhat analogous to that of gunpowder, and the power of each is measured by the elastic expansion of the gases produced. The whole elastic and expansive force concentrated on one point, measures the explosive force in operation, and the amount of this force is evident by the distance to which its reaction against the part opposite to the fracture often carries the massive boiler, or destroys buildings.

An example will illustrate the extent of this force more clearly. Taking the "Lord of the Isles" locomotive, which attracted so much attention at the Exhibition of 1851, and the steam at 120 lbs. per square inch above the atmosphere, it gives an aggregate force of 17,438 tons, as calculated from the surfaces it acts against within the boiler.

Thus, the pressure on the cylindrical shell round the tubes,	= 1259·57 tons.
On the smoke-box tube plate,	= 90·53 "
On the fire-box and plate,	= 376·54 "
On the two outer sides of fire-box,	= 502·07 "
On the outer top plate of fire-box,	= 392·46 "
On the tube plate of fire-box,	= 95·10 "
Total pressure on outer shell.	= 2716·27 tons.
Pressure on the 303 tubes, each 2 inches in diameter,	= 13,569·87 tons.
Pressure on the inner copper fire-box,	= 1152·41 "
Total pressure as divided over the boiler,	= 17,438·55 "

Confined in about 205 cubic feet of space, of which about 42 cubic feet are filled with steam, and 163 cubic feet with water. This is the quiescent force under ordinary conditions, as it is confined in a space of about 205 cubic feet, but which on release seeks instantaneously to occupy a space of about 277,436 cubic feet, equal to atmospheric pressure, which gives some idea of the gunpowder-like expansion of steam and water in explosions. The steam expands with an elastic force equal to that of eight atmospheres, or say to 336 cubic feet, and the water to about 1700 times its own volume, or about 277,100 cubic feet, making a total volume of 277,436 cubic feet, into which they would expand at the moment of explosion. The steam produces only about $\frac{1}{8\,2\,5}$th part of the expansive force, so that the explosive force of the water is by far the most formidable element in all boiler explosions.

On examining the destruction produced by some such explosion as is here supposed, it would be assumed that steam of only 120 lbs. pressure could not have torn iron as a man could tear a piece of cloth, but that enormous pressure had been produced by some neglect, or other cause. As has been shown, the nominal strength of boilers by no means indicate their real strength; any weak point giving way, however slightly, would be acted on by the steam until the elastic strength of the iron was passed, when fracture would ensue by any sudden agitation in the boiler. The point of fracture once reached, the force to be dealt with is no longer that of the divided pressure of the steam, or even its concentrated pressure in the fracture, but the explosive force of the water bursting into steam of 1700 times its volume, all directed towards that fracture, with gunpowder-like force, and gunpowder-like results.

The calm ocean and the carefully-worked boiler are relatively comparative, whilst in like manner the agitatated ocean and irregularly-

worked boiler are both indicative of danger, for each is subject to local atmospheric disturbance, differing only in their sphere of action, yet singularly approximating in their destructive forces. Therefore, as in the ocean storms, only the best craft, under skilful mariners, can live; so with boilers, only the best boilers, under skilful guidance, can give reasonable grounds for safety. The explosive force of the water and steam in a boiler fully accounts for the greatest exhibition of destructive power which may follow any explosion, and the view of the subject will be illustrated by referring to a few examples, chiefly amongst locomotive boilers, as the field of the author's experience. The details of most of them will be found in the Government Railway Inspectors' reports, and other points mentioned were those noted by a personal inspection of several of them after the explosion.

1. The Clyde steamboat, the *Telegraph*, 1842. This was amongst the first of the locomotive class of boiler which burst, and caused so much discussion at the time. The usual pressure was 50 lbs. per square inch, and the steam had been turned on to start the boat, when a peculiar hissing noise was heard, followed by an explosion, which projected the boiler about 60 yards from the vessel. The boiler was on Bury's plan, and the top of the inner iron fire-box was fractured, and exhibited an originally laminated plate, with several blisters on it. It was also stated that it had been twice burnt previously—that is, exposed to the fire without being covered with water, which probably caused the blisters, and greatly increased the original defect.

Here, then, the local defect, the local agitation by turning on the steam, the hissing of the breaking iron, the fracture, and the projectile force, are all distinctly attested, and all compatible with quiescent pressure of 50 or 60 lbs. per square inch suddenly expanding to an atmospheric pressure, and acting on one point, whereby the reaction threw the boiler out of the boat into the water.

2. The "Irk" locomotive boiler, 1845. This explosion took place in the shed at Hunt's Bank, after the driver and fireman had got on the engine to take it out on duty; and as they were both killed, it is not known exactly whether the safety-valve had been tried, or the regulator opened, or not. It is, however, so usual to do one or the other, or both, in such circumstances, that it is highly probable that at least one of them was opened. As it was, the top of the inner fire-box was forced down; the brick-work of the shed under the fire-box was also forced down several inches; the engine, about 20 tons, raised through the roof, carried about 14 yds., and turned end over. The strong connexion with the tender was broken, and it was also turned end over.

There is, therefore, the probable local disturbance of the steam atmosphere; the local fracture, and explosive force, also, in this instance. Indeed, the local action is very distinctly remarked, as confined between the brick-work as an abutment, and the top of the outer fire-box as the centre of a projecting force, so excessive on that point as to break the strong connexion to the tender, turn the tender end over, raise the engine a considerable height through the opposing roof, and land it at 14 yards distance, after having made a complete somersault, by the local reaction of the force on the heaviest end, opposite the fracture.

To be Continued.

For the Journal of the Franklin Institute.

On taking Daguerreotypes without a Camera. By J. F. Mascher.

To the Committee on Publications.

The accompanying stereoscopic pictures were taken by me, by means of a box (to be described hereafter) that contained neither lenses, reflectors, or in short any refracting or reflecting medium of any kind. I accidentally made the discovery that photographic pictures could be taken in this manner while prosecuting some experiments relative to stereoscopic ANGLES.

It is well known that two pictures taken with two ordinary cameras placed only $2\frac{1}{2}$ inches apart horizontally, will not when placed in the stereoscope show proper or sufficient stereoscopic RELIEF, yet it is well known that the human eyes are only placed $2\frac{1}{2}$ inches apart, yet are enabled to see solid objects in their proper solidity and relief; and to explain the why and wherefore of these facts has challenged the attention of Professor Wheatstone, Sir David Brewster, and a host of others, leading the above named gentlemen into a very sharp controversy, leaving the main question, the determination of the proper stereoscopic angles, as far as practical results are concerned, in precisely the same condition in which they found it. Under these circumstances we may be permitted to ask, why is it that two pictures, taken by two cameras placed $2\frac{1}{2}$ inches apart, do *not* show sufficient stereoscopic relief? Why is it that we must place the cameras about eight times farther apart than the human eyes are in order to produce the proper relief? When these questions first suggested themselves to me, the following answer occurred to me without at that time being able to prove it to be the correct one; namely, because the lenses in the cameras ($\frac{1}{4}$ size) are twelve times larger than the human lenses (eyes).

In order to ascertain whether this is the correct answer or not, it was only necessary to take two pictures with two cameras having a diaphragm in each, the opening in which are $\frac{1}{8}$ of an inch in diameter, that being the diameter of the diaphragm in the human eye. In executing this experiment, I was very much surprised to find that the focal RANGE of the camera was increased to an extraordinary extent. The cameras had been focussed for a house on the opposite side of the street, but the moment the diaphragm was introduced, the sash in the window, which before was invisible, suddenly became as sharp and distinct as the house on which the focus had been previously drawn. Subsequently, on removing the camera to an upper story of my house, it was found that this increase in focal range extended not only from the house towards the camera, but to an equal extent beyond the house. After ascertaining these facts, it became desirable to find out the cause of them. With this end in view, the lenses were removed from the tube, and only the diaphragm remained in the same. You may well imagine my astonishment at finding the pictures of houses and other objects in the street faithfully depicted upon the ground glass! the letters of signs, &c., reversed, precisely as if the lenses had been used. The next step was to ascertain whether these pictures possessed photogenic properties, which was soon done by substituting a metal diaphragm with an apperture of $\frac{1}{50}$ of an inch in diam-

eter for the paper one of $\frac{1}{8}$-inch in diameter, putting in a coated plate, leaving it remain 15 minutes, coating it in the usual manner, and a beautiful picture similar to the one herewith sent was the result.

It was self-evident now, that we had the means to do that with one camera, for which two were before deemed indispensable, namely, taking two stereoscopic pictures through two apertures situated only $2\frac{1}{2}$ inches apart. But as a quarter size plate is only $4\frac{1}{4}$ inches long, and as it was desirable to take the two pictures on one plate, two apertures $\frac{1}{16}$ of an inch in diameter were made in the metal plate above alluded to, only $2\frac{1}{4}$ inches apart, and after twenty minutes exposure, the sun shining on the house all the time, the accompanying pictures were the result, thus demonstrating conclusively that two stereoscopic pictures can be taken on one plate with one camera (or dark chamber without lenses) and simultaneously, without either reflectors or refractors of any kind whatsoever!! It may here be remarked, however, that the pictures thus taken on one plate are stereoscopic reverse, that is to say, the right picture is on the side where the left one ought to be, and vice versa, which can, however, be very readily remedied by cutting the plate in two and pasting them together again properly. This stereoscopic reverse was next attempted to be remedied by placing a reflector before the apparatus, but the only effect produced by this device, was the same as the same reflector produces upon pictures taken by an ordinary camera, namely, making the pictures appear in their natural position, so that letters on signs, &c., could be read correctly.

There is another advantage resulting from this camera; it is this. You may make two, four, six, or more sets of holes in the same camera, either all of the same diameter, by which means you will obtain an equal number of stereoscopic pictures with the number of sets of holes, or you may make one set with apertures of $\frac{1}{20}$ of an inch, another $\frac{1}{100}$ of an inch, one set $\frac{1}{70}$ of an inch, and still another set with $\frac{1}{25}$ of an inch in diameter, where you will be certain to obtain at least one set of pictures properly "timed" especially as the other pictures which are not properly timed can be rubbed out before gilding, thus saving the plates.

So much for the actual experiments. Let us see what practical conclusions can be derived from them.

They teach us that a theoretical eye occupies no more room than a *mathematical point*. Secondly, the diaphragm in the human eye is $\frac{1}{8}$-inch in diameter. Thirdly, that the lenses commonly employed in taking photographic pictures vary from $1\frac{1}{2}$ to 6 inches in diameter.

What is the theoretical difference between these three kinds of eyes? What the practical difference?

A board one foot square, placed 5 feet distant before a theoretical eye, will obscure or eclipse a space of 576 square inches of a back ground, situated 10 feet from this eye. The same board, under the same circumstances, placed before the human eye, will obscure only 564 square inches! Whereas, if it be placed before a $\frac{1}{4}$ size camera, under like conditions, it will only obscure 495 square inches!! A double whole size camera, with lenses 6 inches in diameter, will merely obscure 324 square inches. From this it is apparent, that a picture, taken with a camera, with lenses larger than the human eye, will show more of the object

than what the human eye, placed in the same position, will be able to see. A man can place one of his eyes in such a position, that he can see only one ear and the greatest portion of the face of a person. A camera, placed in precisely the same position, will take a picture in which not only all the objects which the human eye had previously seen, but also the other ear will be clearly delineated! Such pictures are anti-stereoscopic; distortions; disfigurations intolerable in proportion to what the lense, with which it is taken, exceeds in diameter the size of the human eye. Such pictures will do for owls to look at! The back and (to the eye) invisible parts of an object are brought out by such large lenses, as prominent as the natural prominent portions of such objects themselves, and producing by their contrast, flat and inanimate pictures, giving to the face, &c., of the subject a broader, longer, and fuller appearance than they appear to a single human eye. We might with the same propriety call the hide of an ox, when spread upon a flat surface, a portrait of that animal, as to call a picture, taken in a camera with such large lenses, a portrait of the "human face divine." Who has failed to notice the immense difference between the large ("the splendid gilt frames!") so called portraits, both on paper and plate, in Broadway, Chestnut, Washington, and Baltimore streets, and the small miniature likenesses frequently met with in medallions, charms, breast-pins, &c., taken with a good small locket camera. The one looks flat, distorted, and inanimate; the other appears to stand and project right out from the plate, ready as it were at a moment's calling to leap into existence as a living being. So much for single pictures. Let us examine double or stereoscopic pictures.

From what has been said, it will be easy to understand how it is that two pictures taken at an angle no larger than that of the human eyes do not show sufficient relief; for if it be true that each individual picture is more flat than the same object appears to a single eye, then it is also true that the two pictures, when combined in the stereoscope, will present less relief than what two similar pictures would do, that were taken by means of lenses only $\frac{1}{8}$-inch in diameter, or the same size of the human eye.

In the human eye we find, as in all other parts of the body, the most extraordinary wisdom displayed, and it is only the hand of Omnipotence that could have designed and constructed such a wonderful organ. Not only do we find a single eye perfect in all its parts, but we also find the two eyes arranged in such a manner as to give the greatest possible amount of effect to binocular vision. Who can devise anything better? To imitate and equal, it ought to challenge our undivided attention.

Who ever saw an animal with two eyes each six inches in diameter and 16 inches or two feet apart? Or who, two small ones forming an angle with the horizon of 45°? My friends in Boston will please forgive me, as I design them no intentional harm.

But what is the difference, it may be asked, if we can compensate, by simply moving the cameras a little further apart, for the deficient stereoscopic relief? To which I answer, that we can indeed make such compensation, but it is always at a little expense of the truthfulness of the picture. Others will no doubt have noticed, as I have done, the great

apparent *shift* of positions of prominent objects in some modern stereoscopic pictures. These prominent objects in the left picture will be found thrown, as it were, to the right; whereas in the right picture they will be found to the left, straining the eye, in some instances very much, in endeavoring to coalesce them. This is especially true with regard to groves of trees, &c. This difficulty is not experienced when looking at the objects themselves, *nor when looking at pictures of such objects when taken*, as the one above alluded to, *through two small apertures only* $2\frac{1}{4}$ *or* $2\frac{1}{2}$ *inches apart.* And I have taken the picture of a street in which the most prominent object was only one foot from the camera (dark chamber) and the most distant one (Christ Church) at least one mile distant, yet not only were both in perfect focus (they could not be otherwise) but the eyes could also see them in the stereoscope in their proper stereoscopic relief, without experiencing the least contortion or fatigue.

In conclusion, I may say, that I think I have proven the superiority of small over large lenses in photography. We can now see that we need not look to the increase in size of the lenses, in our cameras, for the production of large photographic pictures that will at all be entitled to be called correct portraits, but that we must look to the perfection of small lenses, as well as to the quality of the chemicals employed. We want chemicals that will work instantaneously, even with small lenses. The human eye produces instantaneous pictures!

I would suggest a mode of assisting the quick action of small lenses. I would set the subject in the open air; take advantage of all the light that can be obtainad. Who will be the first to build a skylight room, with the roof and walls removed?

Philadelphia, March, 1855.

Gas and Oil from Vegetable Substances. J. H. Johnson, London and Glasgow.—Patent dated January 30, 1854.*

This invention has been communicated to the patentee by MM. Kœchlin, Duchatet, and Perpigna, and is patented in this country on their behalf. It relates to certain modes of producing gas for the purposes of heating and lighting, from turf, wood, tar, and the waste or refuse of various vegetable substances, such as cotton, paper, chips, saw-dust, and other similar articles.

For effecting the production of gas from turf, it is merely necessary to place the dry turf in a gas retort and heat it to a red heat, but this gas has very slight illuminating properties. It burns with an almost entirely blue flame, and is altogether totally inapplicable to lighting purposes. Various means have been adopted for carbonizing this gas, but these have hitherto been found inapplicable in practice. The obviation of these difficulties hitherto met with forms one of the main features of the present invention. The operations, which can never be satisfactory if effected at one time, are divided into two distinct processes, and the carbonization of the turf or peat is conducted so as to produce the best

* From the Lond. Pract. Mech. Journ., Feb., 1855.

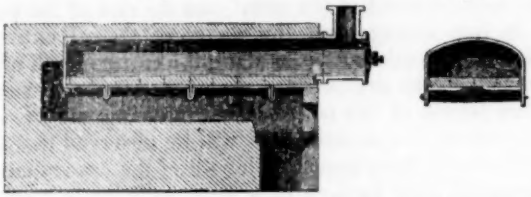
result, both as regards the quantity and quality of fuel, whilst, at the same time, the admixture of an injurious material (oxide of carbon) with the gas for lighting purposes, is avoided. The decomposition of the essential oils of turf or peat is effected, not so much by the superheating of the oils themselves (for which by nature they are not adapted,) but by causing their vapors to make a long circuit through pipes or vessels, heated to a temperature sufficiently great to effect their decomposition and conversion into gas. It is proposed either to mix the gas thus produced by the two operations, so as to obtain a moderate lighting power, or to employ them separately; the first for heating purposes, as will be hereinafter described; and the second for illuminating purposes, being of a superior richness.

The same processes are also equally applicable to the conversion of coal tar into gas. This decomposition and conversion into gas is effected by causing the tar to pass in a state of vapor through the heated passages before referred to. But it is necessary in this case to use particular care on account of the peculiar chemical nature of the material under treatment. The tar obtained from gas works is a composition of fine or well divided coal, agglomerated by essential oils of different degrees of weight and volatility. If the tar is caused to pass directly over heated surfaces, the essential oils are decomposed, and the coal, freed from this species of cement, which held it together, resumes its state of impalpable tenuity, and is drawn by the current of gas into the pipes, these becoming eventually obstructed thereby, the operation being consequently stopped by reason of the great deposit of coal dust in the pipes. This difficulty is easily obviated by introducing the tar (as free from water as possible) into a still or sheet iron retort, similar to those at present employed in the preparation of coal oils. The process of distilling effects the separation of the vapors of the oil, which disengage themselves from the coal which rests in the retort, the latter forming the product known as dry resin, which may be employed as fuel. On leaving the retort, the vapors of the oil, in place of entering a worm to become condensed and form the oil of coal, are passed over a heated surface, as hereinbefore described. In passing along these heated surfaces, the vapors are converted into gas by the action of the heat, and as the particles of coal have been previously separated or removed, the obstruction to the pipes hereinbefore described will be avoided.

Fig. 1, of the accompanying engravings represents a longitudinal vertical section of a retort, in which the carbonization of turf is effected, and fig. 2 is a transverse section of the same. The roof of the retort is of cast iron, and is either elliptical or circular; internal flanches are cast upon the roof, and upon these flanches is supported the bottom of the retort, which is composed of fire clay tiles, luted to each other and to the retort with clay. The waste or refuse of the coal which results from the operation will complete the luting, and effectually prevent any escape or leakage. Lugs are also cast upon the roof, outside the fire clay brick-work. These lugs are united by the transverse tie rods or bolts, which maintain the proper width of the retort, and serve, at the same time, to strengthen and bind together the brick-work. The peculiar construction of this compound retort of fire-clay and cast iron forms an essential fea-

ture of this invention, and offers many advantages. The fire clay bottom of the retort resists better than cast iron the high temperature attained at the termination of the operation, and as its expansion is allowed for,

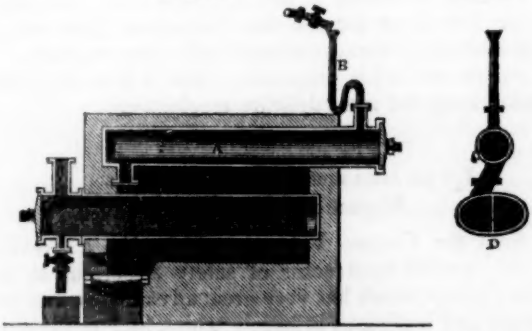
Fig. 1. Fig. 2.



it is not exposed to the inevitable fracture to which retorts composed entirely of fire clay are subjected by the changing of temperature. The same liberty of contraction and expansion enables also the cast iron portion of the retort to resist the destructive changes of temperature, and, at the same time, permits the heat from the fire bricks to enter the interior of the retort. This retort is placed in a furnace, which is so arranged, by the aid of flues, that the whole surface of it may be equally heated. The retort is connected with an ordinary retort head fitted with pipes for the disengagement of the vapors. The vapors enter a refrigerator, which may either be of the form of a worm, or still better, similar to the air condenser generally employed. In this condenser is effected the condensation of the ammoniacal waters, and the oils which are collected separately. The non-condensable gas passes off to the gasometer, previously traversing, however, through lime purifiers.

Fig. 3 of the engravings represents a longitudinal vertical section of an apparatus for effecting the conversion of volatile oils into gas; and Fig. 4 is a transverse section of the same. A cast or wrought iron cylinder, A, which is partially filled with fragments of carbonized turf, receives the volatile oils by the syphon pipe, B, which is itself supplied by a pipe communicating with an upper reservoir or vessel, and fitted with a cock,

Fig. 3. Fig. 4.



by means of which the flow of oil may be regulated. The entire apparatus is placed in a furnace and heated equally over its whole surface. As fast as the oil enters the cylinder A, it is evaporated, and passes in the state of vapor to the pipe, C, which communicates with the retort, D.

This retort, which is of cast iron, and of the same length as the cylinder, A, is divided longitudinally into two distinct chambers by a partition, which is cast in one piece with the body of the retort, and extends from the front end of the same to within a short distance of the other extremity, so as to afford a passage or communication from one chamber to the other between the end of the retort and the end of the partition or diaphragm. By this arrangement the vapors of the oil enter near the end of the retort on one side, and pass along the entire length of the same through the opening into the second chamber, passing a second time along the entire length of the retort before arriving at the exit pipe. From the arrangement just described, it will be observed that the vapors have to traverse nearly three times the length of the apparatus, and they are subjected during their passage to a heat sufficiently great to cause the decomposition required. A small pipe fitted to the under side of the retort head allows of the withdrawal of the non-vaporized oil, or the vapors which may have condensed in the exit pipe. The oil thus drawn off is replaced in the upper reservoir or supply vessel, and again passed through the apparatus. The pipe, E, communicates by a dip pipe, as in the ordinary arrangement of gas apparatus with a receiving cylinder partially filled with water. From this cylinder the gas passes into a condenser, which effects the separation of any particles of oil which may not have been decomposed. This oil is also reconveyed to the supply reservoir or tank, to be again passed through the apparatus. From the condensers the gas passes to the lime purifiers, and thence to the gasometers, where it is mixed with the gas produced from the carbonization of the turf. We have as yet described only one application of the essential oils derived from carbonized turf—namely, their conversion into gas; but as in order to render this gas sufficiently powerful for lighting purposes only ten or fifteen per cent. of the oil is required, and as the turf supplies twenty-five or thirty per cent. of such oil, it follows that there will be a considerable quantity remaining. By this means the price of the gas will be considerably reduced, as the purposes to which the remaining oils may be applied will bring in a considerable revenue. The patentees further specify modes of making the following products from the oil hereinbefore referred to:—1st. A liquid almost free from odor, suitable for burning in lamps, or for the manufacture of hard varnish. 2d. Grease for lubricating railway carriage and other wheels. 3d. Hard soaps for the toilette and other purposes. 4th. A thin oil of fine quality, suitable for lubricating the most delicate mechanism.

For the Journal of the Franklin Institute.

Magnetic Water Gauge.

We learn from the *Cosmos*, Vol. v. p. 630, that a Frenchman, M. Lethuillier Pinel, special constructor of safety apparatus at Rouen, has invented a water gauge which has very great advantages, and is "founded on a very simple and ingenious principle which had never yet been applied to this use." The description is of a blundering modification of Faber's magnetic gauge. It has been favorably reported on to the Society for the Encouragement of National Industry.

Really the ignorance (real or affected) of these men who cannot be made to know anything which takes place out of their own city or country renders them unfit to express an opinion on a mechanical invention. One would think that French industry might be better applied than in pilfering inventions from others. We refer *Abbè* Moigno, to Vol. xxi, Third Series, p. 215, of our Journal, (March, 1851,) for the very superior original form of the instrument to which he dedicates so much space, but not more than its utility and the ingenuity of the true inventor, Mr. Faber, deserves. F.

For the Journal of the Franklin Institute.

On transmitting two Messages at the same time in Opposite Directions by the Galvanic Telegraph.

Considerable attention has been excited in our Journals, by the announcement that Dr. Gintl, Director of the Austrian Telegraphs, had succeeded in sending two messages at the same time in opposite directions through the same wire between Lintz and Vienna. The *Cosmos*, Vol. v, p. 688, contains some account of this experiment from a communication by M. Zantedeschi, from which it would not appear that there was any sufficient evidence of this fact. The experiment of M. Zantedeschi in confirmation, is, as M. Moigno remarks, entirely fallacious. There can be no difficulty in imagining two pulsations or waves of electricity to pass each other on a wire as two waves may be seen to do in water, but whether it has been done, is, as yet, questionable. F.

On the Applicability of Gelatine Paper as a Medium for Coloring Light.

By Horace Dobell, Esq.*

The object of this communication is threefold.

1. To point out the properties of a material called Gelatine Paper, which render it applicable as a medium for coloring light.

2. Through the means of gelatine paper, to introduce the use of colored light in the arts for the preservation of the sight of artisans.

3. To introduce the use of gelatine paper for the relief of persons suffering from impaired vision; for the preservation of the sight of travelers, and of all those who are much engaged in reading.

This material was invented in 1829 by the late M. Grenet, of Rouen, and was exhibited by him in its present state of perfection at the Great Exhibition of 1851. But up to the present time it has not been successfully applied to any more useful purposes than the manufacture of artificial flowers, address cards, tracing paper, wafers, wrappers for confectionary, and the like.

It is commonly manufactured in sheets, measuring 22 inches in length and 16 inches in diameter, which are sold at a small price; but the sheets can as easily be made of any dimensions not exceeding those of which plate-glass is capable. It can be made of any thickness, from that of the finest tissue paper upwards. It may be obtained as transparent as the best glass, and more free from color, or of all colors and shades of color, without interfering with its transparency. It is exceedingly

* From the Lond., Edin., and Dub. Philos. Mag., Feb. 1855.

light, and may be bent or rolled up without injury. It can be cut with scissors like ordinary paper, and may easily be stitched with a needle and thread. By means of an aqueous solution of gelatine, it can be made to adhere accurately to plates of glass without any interference with its transparency. When varnished with collodion it becomes perfectly waterproof, more pliable, capable of bearing a considerable degree of heat without injury, and its transparency is not affected.

Hence it appears, that, in addition to its transparency and susceptibility to various colors and forms, gelatine paper is cheap, portable, and durable.

Such being the properties of the material, the following are enumerated by the author as some of the forms in which he suggests that it may be employed, and in which it has already been found useful.

1. A small sheet of very pale green or blue gelatine paper, to be used in reading. The sheet is simply to be laid upon the page of the book, and the reading to be conducted through the colored medium. If used in a faint light, the reading paper is to be raised a little from the book to admit more light beneath it.

2. A sheet of gelatine paper of pale green set in a light frame, and placed like a screen before the window or lamp of the engraver, the watch-maker, the jeweller, and the like; thus providing a light of genial color in which they may pursue their occupations.

3. A similar appliance to the last mentioned for the use of needlewomen. For this purpose screens are to be provided, both of green and of blue gelatine paper; so that the white materials employed in needlework may be changed to a pleasant green, by the screen of that color, the yellow materials to a green by the blue screen, and by one or other of these screens the reds softened down into violets or browns.

4. For either of the two last purposes on a larger scale, the gelatine paper may be attached to the window glass of the apartment, thus coloring, if necessary, all the light admitted during day-light.

5. Shades for the eyes in certain affections of the sight, to take the place of the green or blue silk and card shades worn by many persons. The gelatine paper being transparent, will allow the wearer to see his way about, at the same time that the eyes are protected from a glaring light. This may be especially useful in cases where it is desired not only to shade a diseased eye, but also to protect its nerves from strong light admitted by the sound eye. When not only colored light but a certain degree of darkness is required, this can be readily and delicately graduated by employing shades of different depths of color.

6. Masks of gelatine paper for protecting the eyes of travelers against the glare of snow fields and of sandy deserts.

On some of the Thermo-electric Properties of the Metals Zinc and Silver.
By Richard Adie.*

A zinc and silver thermo-electric couple is known to reverse the direction of the current of electricity generated by heating it, when the temperature of the joint is raised above 248°, as described by the late Professor Daniell in his Introduction to Chemical Philosophy, p. 468. This

* From the Lond. Journ. of the Chemical Society, Jan. 1855.

peculiar property I have made the subject of the following experiments, which I hope may prove interesting, for they show how completely thermo-electrical currents are governed by resistance to conduction in the joints of the couples.

Experiment I.—A piece of zinc wire was soldered to a piece of silver by pure bismuth for a solder, and the joint was made strong with a large surface of bismuth in contact with the metals. On heating this couple by dipping the joint in oil raised to different temperatures, the reversal of the current alluded to above was observed; for temperatures under 250°, zinc was positive, and for temperatures above that point, silver was the positive element.

Experiment II.—The same zinc and silver as in the last experiment, with bismuth surface in contact with the metals, made as small as practicable. The heat was applied by dipping the joint in oil raised to various temperatures from 100° to 360°, and in all, the silver was the positive metal. The peculiar property of the reversal of the current, as the temperature passed a certain point, had disappeared with a change in the joint, which had only increased its resistance to conduction.

Experiment III.—The same zinc and silver couple employed with a joint formed without solder. The two surfaces of the metals were cleaned, and bound firmly together with thread, with only small portions of each element in contact. The result of this experiment was the same as No. 2; the silver stood positive for all temperatures.

Experiment IV.—The same zinc and silver were joined by a bismuth soldering, so as to form a continuous straight wire, with a bismuth joint in it, of which the surface in contact with the metals was nearly equal to the section of the wires. When heat was applied to the zinc wire, about two-tenths of an inch from the joint, silver was positive for all temperatures. And when heat was applied in a similar manner to the silver wire, the zinc became the positive metal for all temperatures. In this experiment, *the direction of the flow of heat across the joint governed that of the thermo-electric current generated;* it is a result which I have met with in many other thermo-electrical couples tested in like manner.

Experiment V.—A piece of zinc wire cut in two halves formed the couple for this experiment, with the joint formed by tying them firmly together; for temperatures under 300°, this arrangement showed very slight thermo-electrical effects; for higher temperatures more decided evidence of electrical action was obtained, but the direction of the currents generated was not regular.

Experiment VI.—The same pieces of zinc as for the last experiment, No. 5, with a bismuth joint, formed in the same manner as for experiment No. 4. This formed a delicate thermo-electrical couple. When the right side of the joint was heated, the left wire was positive; and when the left side was heated, the right became positive; these effects could be readily shown by grasping the wires in the fingers. A similar experiment was made with a silver wire cut in two.

Experiment VII.—A piece of silver wire and a bar of bismuth formed the couple for this experiment. It may be premised that bismuth is a metal strongly positive to every other, and that the object in view was to endeavor to exhibit it as a negative element. For the joint, the point

of the silver wire was heated in sulphur until it was thickly coated with a sulphide of silver, and the sulphuretted portion was tied firmly down to the bismuth. On heat being applied to the silver, the couple did not become active* till the temperature was near 400°, when the bismuth showed itself the positive metal. On heat being applied to the bismuth bar, near the joint, the couple became active as before, at a high temperature, *and silver stood as a positive thermo-electric element to bismuth.* The experiment was tried with a thin coat of sulphide on the silver, when the couple became active at a lower temperature; but bismuth then stood positive to silver when heat was applied on its side, as well as when heat was given on the silver side.

Experiments like these, showing the direction of thermo-electrical currents to be under control, can be multiplied in great variety.

On the Formation of Brass by Galvanic Agency.†

Copper is more electro-negative than zinc, and separates more easily from its solutions than a metal less negative. If, then, in order to obtain a deposit of brass by galvanic means, we employ a solution containing the two component metals, copper and zinc, in the proportions in which they would form brass, there will only be produced by the action of the battery a deposit of real copper: the zinc, more difficult of reduction, remains in solution. What must be done, then, to obtain a simultaneous precipitate of the two metals in the proportions required, is either to retard the precipitation of the copper, or to accelerate that of the zinc. This may be effected by forming the bath with a great excess of zinc and very little copper.

Dr. Heeren gives the following proportions as having perfectly succeeded:—

There are to be taken of	Sulphate of copper,	1 part.
	Warm water,	4 parts.
And then	Sulphate of zinc,	8 "
	Warm water,	16 "
	Cyanide of potassium,	18 "
	Warm water,	36 "

Each salt is dissolved in its prescribed quantity of water, and the solutions are then mixed; thereupon a precipitate is thrown down, which is either dissolved by agitation alone, or by the addition of a little cyanide of potassium: indeed, it does not much matter if the solution be a little troubled. After the addition of 250 parts of distilled water, it is subjected to the action of two Bunsen elements charged with concentrated nitric acid mixed with one-tenth of oil of vitrol. The bath is to be heated to ebullition, and is introduced into a glass with a foot, in which the two electrodes are plunged. The object to be covered is suspended from the positive pole, whilst a plate of brass is attached to the negative pole. The two metallic pieces may be placed very near.

The deposit is rapidly formed if the bath be very hot: after a few minutes there is produced a layer of brass, the thickness of which augments rapidly.

Deposits of brass have been obtained in this way on copper, zinc,

* A delicate galvanometer showed no indication of the passage of an electrical current.

† From the London Artizan, February, 1855.

brass, and Britannia metal: these metals were previously well pickled. Iron may, probably, also be coated in this way; but cast iron is but ill adapted for this operation.—*Mittheilungen des Hannov. Gewerbevereins*, through *Bulletin de la Société d'Encouragement*, *No.* 16, *August*, 1854.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, April 19th, 1855.

John C. Cresson, President, in the chair.

John Agnew, Vice President,
Frederick Fraley, Corresponding Secretary,
Isaac B. Garrigues, Recording Secretary,
} Present.

The minutes of the last meeting were read and approved.

Letters were read from the Regents of the University of the State of New York, and Uriah A. Boyden, Esq., Boston, Massachusetts.

Donations to the Library were received from the Royal Astronomical Society, and the Statistical Society, of London; Col. J. J. Abert, Chf. Corps Top. Engrs., and Prof. A. D. Bache, Super. Coast Survey, Washington City, D. C.; Wendel Bollman, Esq., Baltimore, Maryland; John S. Dodge, Civ. Eng., Rome, New York; Aug. F. Dalson, N. York; Jas. B. Francis, Civ. Eng., Lowell, Mass; and Prof. J. A. Kirkpatrick, Dr. T. S. Kirkbride, James H. Bulkley, Dr. Charles M. Wetherill, Parry & McMillan, Uriah Hunt, and Geo. M. Conarroe, of Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Board of Managers and Standing Committees reported their minutes.

The Standing Committee on Exhibition presented a printed copy of their report on the last Exhibition.

The Treasurer read his statement of the receipts and payments for March.

The candidates for membership in the Institute, (6,) were proposed, and the candidates proposed at the last meeting, (5,) were duly elected.

The Corresponding Secretary stated that Prof. Frazer was on the eve of going to Europe, to be absent for several months, and offered the following resolution, which was adopted, viz:

Resolved, That the Institute do most cordially commend Prof. Frazer to the confidence, attention, and respect, of their foreign Associates and Corresponding Societies, and ask for him such introduction to men of Science, and to the Cabinets and Libraries of Europe, as may be in their power to afford.

On motion, the Corresponding Secretary was instructed to present the thanks of the Institute to Uriah A. Boyden, Esq., of Boston, Mass., for his donation of One Hundred Dollars, presented in his letter read this evening.

Dr. Rand exhibited a model of "Atkins' Self-Acting Automaton Reaper." This invention has been reported upon by the Committee on Science and the Arts, and the report published in the *Journal*, Vol. xxviii, Third Series, p. 144, August, 1854.

Washington Jones presented to the notice of the members, the model

of a Steam Cylinder Piston, designed by Messrs. Morris, Tasker & Morris. One on the same plan has been used by them with a satisfactory result. No springs or set screws are required to keep the packing rings in contact with the surface of the cylinder, the adjustment being made in this way: a ring of metal with an exterior diameter somewhat less than the bore of the cylinder, and having its outer part turned so that it forms a double truncated cone, placed base to base, serves as the setting out piece. To give it elasticity, a piece is cut from it, say one-quarter of an inch in length, the two ends standing apart that distance when the ring is subjected to no strains. The outer part of the ring is removed to a certain depth by concentric saw cuts occurring at regular intervals; this is for further increasing the elasticity. The packing rings are fitted one on either side of the setting out ring; the surfaces in contact conforming in shape. As the rings wear, they are pressed out by tightening up the follower bolts, which forces the rings towards the bases of the truncated cone, formed by the middle, or setting out ring, thus increasing their diameter, a long diagonal cut being made in the packing rings to allow for their expansion.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Andrew Mayer's Gas Nipples.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a "Self-regulating Gas Nipple, to govern the flow of Gas to burners," invented by Mr. Andrew Mayer, of Philadelphia, Pennsylvania—REPORT:

That this regulator is formed from a cylindrical block of brass or other suitable metal $1\frac{1}{8}$-inch long and $\frac{9}{16}$ths diameter; the upper $\frac{5}{16}$ths is turned down and has chased upon it a thread to receive the burner; the lower end is drilled $\frac{1}{2}$-inch deep and $\frac{5}{16}$ths diameter, and has chased within it a female thread to fit the supply pipe. From the lower end a drill $\frac{1}{4}$-inch diameter is run in $\frac{5}{16}$ths beyond the thread to form a cavity and seat for the reception of a valve. From the upper end of the block a drill $\frac{1}{8}$-inch diameter is run through into the valve chamber, and this hole is reamed out to $\frac{1}{4}$-inch diameter at the top end, tapering to $\frac{1}{8}$-inch at its entrance into the valve chamber. The seat for the valve is then perfected with a drill suitably beveled run in from the bottom of the block. The valve is of a conical form $\frac{1}{4}$-inch long and scant $\frac{1}{4}$-inch diameter at the lower end. It is made by stamping from thin sheet brass, and consists of three triangular leaves united at their apices; these leaves are rounded up in a mould so that their edges overlap slightly, and the apex of the cone is pierced by a small opening varying in different regulators from $\frac{1}{50}$th to $\frac{1}{70}$th inch diameter. The burr formed by drilling is allowed to remain, and is of material assistance in adapting the flow of gas to the requirements of the burner employed. The lower end of the valve is open, and the lower edge is left irregular, so as to allow of the passage of a considerable amount of gas when the pressure is low and the valve consequently resting upon the bottom of the chamber.

The average weight of the valve used with the ordinary union jet consuming four cubic feet of gas per hour, is one grain. To retain the valve in its chamber, use is made of a metallic cup perforated by a hole $\frac{1}{16}$-inch diameter; this is forced into the bottom of the chamber, and forms a rest for the valve when down from its seat, and allows a play of about $\frac{1}{16}$th of an inch.

The object of this regulator is to equalize the supply of gas to the burner. In all ordinary gas mains the supply of gas to individual burners is continually varied by variations of the number of lights receiving gas from them, and as every burner has some particular stage of consumption at which it gives the greatest light for its expenditure of gas, it is important to maintain that condition as nearly as possible. This is partially done by the governors usually placed upon the large supply mains at the points of supply. But the influence of local causes cannot be overcome except by carefully adjusting the supply to each burner, and as this becomes a matter of much trouble when done by hand, many devices have been contrived to approximate the adjustment mechanically. Among the first of these regulators were miniature governors, similar to those used by gas works upon the great mains, placed upon each service pipe near the metre. These were perfect adjusters so long as care was taken to regulate the burners, or the supply to each burner individually, by plugging it in such way as to ensure its proper action at some fixed pressure. But the want of this knowledge and the extravagant prices demanded for them by the makers have prevented their general use.

Regulators for individual burners were then introduced, but as any apparatus depending upon the pressure of the atmosphere was considered too cumbersome and expensive to be multiplied in the same degree as the burners, other means were employed to adjust the flow of gas. The principle generally employed is that of producing a greater or less amount of friction by causing the gas to flow through smaller or larger orifices in the supply pipe in proportion as the pressure became more or less. The most favorite form of apparatus is a cylindrical chamber in the lower part of the burner, in which is placed a circular plate or plates of metal perforated in the centre with a hole large enough to allow the passage of the proper amount of gas at the higher pressures, and the plates light enough to be raised to the top of the chamber by the friction of the gas passing through the central opening. The plates having a burr or other roughness upon the lower edge, raising them slightly from the bottom of the chamber, and allowing an amount of gas to pass beneath in addition to that passing through the centre opening when the pressure was insufficient to raise the plate. This regulator should be so adjusted, that the plate remains stationary at the bottom of the chamber until the passage of gas just exceeds the maximum required for the proper consumption in the burner, at which point the plate would be lifted against the top of the chamber by the friction of the passing gas, and the supply restricted to the amount capable of passing through the central opening, which should be sufficient to supply the burner at a point slightly below the maximum. The objections to this instrument are the small range of pressure ($\frac{6}{10}$) that it adapts itself to, its liability to catch against the sides of the chamber from its form, and the liability to adhere to either extre-

mity of the chamber in consequence of the deposit of any oil or tar upon its extensive surface in contact with them.

A later regulator claims for its efficiency the inertia of the gas. In this contrivance the gas is introduced to the burner through narrow passages of a tortuous form, and is also compelled to pass through a series of openings. It is claimed that the sudden change of direction retards the gas in proportion as the pressure tends to increase the velocity. In comparative experiments it has been found that the change of direction produces no appreciable effect; and that practically, similar results may be obtained by simply obstructing the supply pipe with a plug of wood pierced with a small hole or holes of sufficient area to pass the quantity of gas required for any given pressure. Mr. Mayer's regulator consists, as has already been stated, of a chamber containing a conical valve of extremely thin metal, and acts upon the same principle as the ordinary plate regulator, but according to the result of experiments tried upon it in comparison with all the others, it gives a much greater range of useful effect than any of them.

In performing these experiments, arrangements were made for ascertaining the pressure on both sides of the regulators, or in other words, the friction of the apparatus, upon the proper adjustment of which its efficacy depends. Comparisons were also made by suddenly increasing or diminishing the number of lights supplied by the same service, and the effect of gradual diminution and addition to the pressure, as also the effect of lights at different elevations upon the same service pipe. To obtain the friction of the regulators, gauges were attached to the supply pipe and also beneath the burner; the supply pressure was then varied from $\frac{1}{10}$th to $4\frac{5}{10}$ths by increments of $\frac{1}{10}$th, and the gauge beneath the burner noted for each variation. These comparisons were carried out upon over forty regulators, and the table marked A, exhibits the results in three cases, which are considered fair samples of the whole number. To obtain the effect of local changes, a service pipe of convenient length was prepared, having outlets for 24 burners. Upon these were placed 20 burners with Mayer's regulators adjusted in the usual way. One of Mayer's with friction gauges attached, and three other regulators, samples of the kind already described, also properly adjusted. The results are exhibited in the table marked B. The column *a*, shows the pressure upon the main service; *b*, the pressure beneath the burner with Mr. Mayer's regulator; *c*, the number of lights burning; *d*, *e*, *f*, the condition of the flame upon the other regulators.

The effect of the placing of one light above the other upon the same service was the addition of $\frac{1}{10}$th pressure for every 14 feet of height, and by partially closing the small hole in the point of the cone of the upper regulator in the manner employed by the inventor to adapt the regulator to the burner, similar results were obtained upon the pressure gauges under burners placed at very different altitudes. By examination of the results obtained, it appears that the relative ranges of useful effect rank in the following order:—

Mr. Mayer's regulator.	Other regulators.		
$(\frac{4}{10}\ a\ \frac{6}{10}\ a\ \frac{8}{10}\ a\ \frac{35}{10})$	$(\frac{20}{10}\ a\ \frac{34}{10})$	$(\frac{20}{10}\ a\ \frac{30}{10})$	$(\frac{10}{10}\ a\ \frac{15}{10})$
$\frac{29}{10}$ variation of supply.	$\frac{14}{10}$	$\frac{10}{10}$	$\frac{5}{10}$

The fractions within the brackets express the pressures upon the supply pipe. Those below them the range of useful effect.

An examination of the cause of the great range of useful effect produced by Mr. Mayer's regulator has led to the conclusion, that its continued efficiency after the pressure has caused the valve to rise, depends upon the fact that it consists of separate triangular leaves of very thin metal united by a small section at the top, affording a broad surface with long leverage (nearly the whole length of the valve) for the pressure to act upon and open out the valve to fit more neatly the sides of the chamber, and thus diminish the leaking between the sides of the cone and its seat; as the pressure diminishes, the spring of the metal causes the valve to resume its original form, and a still greater reduction of pressure finally allows the valve to drop, and permit the passage of gas around its periphery as well as through the centre opening. In conclusion, it may be stated that although this cannot be characterized as a perfect regulator, it appears to approximate to such more nearly than any other adapted to single burners.

To prevent misapprehension as to the utility of pressure regulators generally, it should be remarked, that where the burners in use are properly adapted to the quality of the gas and the pressure under which it is delivered, no advantage results from the use of a regulator; but as the great variety of burners in common use makes it impossible to adapt the street pressure to all, such a device becomes highly useful in conjunction with burners of least pressure, for which purpose the regulator under examination may with propriety be recommended.

Table A.

Pressures in inches of Water.				Pressures in inches of Water.			
On service.	On burners No. 1.	No. 2.	No. 3.	On service.	On burners No. 1.	No. 2.	No. 3.
·1	·1	·1	·1	1·6	·4	+ ·3	·35
·2	— ·2	— ·2	— ·2	1·8	·4	·35	— ·4
·3	·2	·2	·2				Best.
·4	— ·3	·3	·3	2·0	·5	+ ·35	·4
	Fair flame.	Best.	Best.		Best.		
·5	+ ·35	·4*	·4*	2·5	·6	— ·4	·5
·6	+ ·45*	+ ·2	·2			Best.	
·7	·3	+ ·2	+ ·2	3·0	·65	·4	·6
·8	·3	·25	— ·3	3·5	·7	·45	+ ·7
·9	·3	+ ·25	·3			Blowing.	Blowing
1·0	·3	— ·3	·3	4·0	·75	·5	·8
1·2	·35	·3	+ ·3		Blowing.		
1·4	+ ·35	·3	+ ·3	4·5	·8		

* Valve rose.